Infrastructure Public-Private Partnerships

Risk factors and agents' participation

Maria do Sacramento Bombaça Basílio

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Abstract

Infrastructure investments are essential to achieve economic prosperity, promoting growth and enhancing well-being. Any infrastructure project is a long-term and complex project, particularly due to the specific nature of the assets and because it involves numerous stakeholders with different interests and objectives. In such conditions, uncertainty and risks are emphasized.

Financing infrastructure is particularly challenging given the amount of funds required that are mostly sunk costs. An attractive mechanism, in the governments' perspective, is to use Public Private Partnerships (PPP) and Project Finance techniques. Multilateral Development Banks (MDB) assume an important role on the raise of funds. Besides their primary lending function, another relevant role emerges - risk reduction.

Public entities encourage private sector involvement in infrastructure particularly through PPP. These partnerships are used to reduce the infrastructure gap and accelerating the delivery of public assets and services with clear advantages over traditional methods of procurement. Theoretically, economic reasons may be presented supporting PPP.

Portugal has a long history using PPP but there are very few papers on the field. In this dissertation, the Portuguese experience is presented with a focus on five projects. In addition, a model to access the relative operational performance of the SCUT concessions is developed using Data Envelopment Analysis.

PPP are particularly relevant to developing and emerging countries where the less stable environment emphasizes risks. Different country's risk factors affect PPP arrangements, conditioning the investments intensity and the participation of the private agents, as well as, of MDB. To explore these issues, an empirical analysis is performed using PPP data from 1990-2007. The results indicate the dominance of the economic conditions and of the legal framework, to explain the agents' participation in PPP and, MDB' participation is higher for riskier countries, confirming the mechanism of risk reduction.

Keywords: *Public-Private Partnerships, Infrastructure, Risk, Developing countries*

JEL classification: G24; G38; H54; L14; L32

Ao meu marido e filhos,
Vítor, Hugo e João

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Abbreviations

ABS - Asset Backed Securitization

AME - Average Marginal Effect(s)

BAFO - Best and Final Offer

BLT - Build, Lease and Transfer

BOO - Build, Operate and Own

BOOT - Build, Own, Operate and Transfer

BOT - Build, Operate and Transfer

BRIC - Brazil, Russia, India and China

CBA - Cost-Benefit Analysis

CLO - Collateralized Loans Obligations

CP - *Caminhos de Ferro Portugueses, EP*

DBFO - Design, Build, Finance and Operate/Manage

DBFOT - Design, Build, Finance, Operate and Transfer

DBO - Design, Build and Operate

DEA - Data Envelopment Analysis

DGTF - *Direcção-Geral do Tesouro e Finanças*

DMU - Decision Making Unit

ECA - Export Credit Agency

EIB - European Investment Bank

ENPV - Economic Net Present Value

EURIBOR - Euro Inter-Bank Offered Rate

EUT - Expected Utility Theory

EU-TENS - Trans-European Networks

FDI - Foreign Direct Investment

GASEPC - *Gabinete de Acompanhamento do Sector Empresarial do Estado, das Parcerias Público-Privadas e das Concessões*

GDP - Gross Domestic Product

HMT - Her Majesty's Treasury

ICT - Information and Communication Technology

IFC - International Finance Corporation (World Bank Group)

IMTT - *Instituto da Mobilidade e dos Transportes Terrestres*

InIR - *Instituto das Infra-estruturas Rodoviárias*

INTF - *Instituto Nacional do Transporte Ferroviário*

LIBOR - London Inter-Bank Offered Rate

LL - Log Likelihood

LPM - Linear Probability Model

LR - Likelihood Ratio

MDB - Multilateral Development Bank(s)

MDG - Millennium Development Goal(s)

MIGA - Multilateral Investment Guarantee Agency

MLE - Maximum Likelihood Estimation

MST - *Metro Sul do Tejo*

ODA - Official Development Assistance

OECD - Organisation for Economic Cooperation and Development

OLS - Ordinary Least Squares

OPPP - Observatory of Public Private Partnerships

PF - Project Finance

PFI - Private Finance Initiative

PPI - Private Participation in Infrastructure

PPIAF - Public Private Infrastructure Advisory Facility

PPP - Public Private Partnership(s)

PSC - Public sector comparator

R&D - Research and Development

REFER - *Rede Ferroviária Nacional*

SCUT - *Sem Custos para o Utilizador final*, Shadow toll highways

SPV - Special Purpose Vehicle

TC - *Tribunal de Contas*, the Portuguese Supreme Court of Auditors

TGV - *Train à Grande Vitesse*, high-speed train

UK - United Kingdom

URF - *Unidade de Regulação Ferroviária*

VfM - Value for Money

Chapter 1

Introduction

Infrastructure investments are essential to promote economic growth and development. The World Bank (1994) estimates that, in general, a one percent increase in infrastructure is associated with a one percent increase in GDP and even more "the adequacy of infrastructure helps determine one country's success and another's failure".

The long-term need for infrastructure remains large, in both developed and developing countries. Particularly to developing countries, infrastructure investments are critical to foster the path to development. Trends like globalization, deregulation of key business sectors such as telecommunications, power or transportation and the privatization of government-owned entities, improved the participation of the private sector and the use of Project Finance (PF) as the preferred vehicle to finance large infrastructure investments.

According to the World Bank (2004), only Latin America countries need US$50 billion of infrastructure investment per year over the next decade. China's infrastructure investment needs remain massive, estimated at about US$2 trillion during the 2001-2010 periods. Concerning sectoral needs in developing countries, the electricity sector required an investment of US$120 billion / year from 2001 to 2010, and US$49 billion / year for water and sanitation from 2001 to 2015.

In developing countries, the poor quality of infrastructure services, the financial constrains faced by many governments and underdeveloped local capital markets contributed to involve the private sector in providing infrastructure services. It is now increasingly recognized that the private sector can play a dynamic role in accelerating growth and development. The involvement of the private sector can bring with it, additionally to a way of raising the necessary funds

and thus, eliminating the *funding gap*,[1] the ability to implement projects in a shorter time, the expectation of more efficient operation, better management and higher technical capability. Private sector involvement can take many forms, but in recent years, Public Private Partnerships (PPP) with its variants, have become the primary form of private participation in infrastructure.

PPP are, in general, long term cooperation agreements between the public sector and private sector for the provision of an asset, socially relevant, an infrastructure or a service. Typically, the private sector is responsible for design, built, finance and operate the new asset. The possibility of risk transfer from the public sector to the private sector is at the heart of the PPP model and the main reason for its recent expansion.

Infrastructure investments are prone to particular risks, namely the existence of natural monopolies that exclude competition, the assets nature (capital-intensive, immobile and not easily redeployed for other uses), non-tradable outputs and in addition, pricing problems may appear, related to the political sensitiveness of the services to be provided.

Moreover, for projects developed in emerging countries, risks are enhanced from the combination of country risks with the risks that are typical of this class of assets, making apparently, such ventures not appealing for private investors. In this context, Multilateral Development Banks (MDB) assume a critical function, mitigating risks and increasing the feasibility of PPP.

MDB are an important actor concerning infrastructure projects. Besides the traditional lending function, important new functions emerge like credit enhancement and mechanism of risk reduction, facilitating the raise of private flows, and also helping governments to perform the necessary reforms.

As such, political, legal, social, economic and financial risks may be even more important in developing countries than in developed ones due to the less stable environment and as a consequence, this same conclusion seems to be evident about the participation of MDB in PPP arrangements, for those countries.

[1]The funding gap results from infrastructure requirements that far exceed the currently available financing resources of the public sector (Fitch Ratings, 2004). Also called the infrastructure gap (Deloitte, 2006).

This research is focused in developing / emerging countries, first, because the data available is concerned with these countries and second, given the enhancement of risks that characterized this group of countries, the analysis of the determinants of infrastructure PPP using proxies for the different risk dimensions is expected to provide richer and more interesting results.

To address these issues, the main goal of this thesis is to perform an empirical analysis of the cross-country determinants of private sector and MDB participation in PPP, using developing countries data from the World Bank PPI database. To shed more light into the risk mitigant effect of the participation of MDB in PPP arrangements, the number of projects with MDB participation and the dollar value of the support provided by these agencies for the projects developed in each country/year is also considered. Simultaneously, we explore which country's factors influence PPP investments and the total count of PPP projects.

A related issue and because Portugal has a considerable history using PPP, but surprisingly there are very few papers on the topic, our second goal is to study the Portuguese experience with PPP. Therefore, this work presents the Portuguese experience, based on a detailed analysis of five of the major infrastructure projects and programmes developed under PPP schemes. The main purpose is to identify success factors and challenges for each PPP. In addition, a model to ascertain the relative efficiency of the SCUT concessions is developed using Data Envelopment Analysis. This technique provides an overall measure of efficiency, although it only allows comparisons within a homogeneous group.

Particularly in a context of a worldwide financial crisis, these topics are gaining relevance to all engaged in the PPP markets, namely, governments, private investors, financial institutions, regulatory agencies and the society in general. It is worth to mention that infrastructure projects are seen as counter-cycle measures to revitalize the economy, particularly under PPP schemes. First, because it is expected that infrastructure investments have a positive impact on economic growth and employment creation, and second, given the budgetary and fiscal constrains that limit the governments ability to fund these projects directly. Simultaneously, Portugal with its PPP policy is facing severe criticisms, given the high debt burden and affordability issues. In this context, an objective assessment of the merits and drawbacks of each PPP arrangement is valuable.

This thesis is organized as follows:

Chapter 2 defines infrastructure projects, with the associated features of uncertainty and risk. The major steps in project management are mentioned and in addition, a classification scheme of risks is presented;

Chapter 3 details the traditional sources of infrastructure finance. In addition, a particular emphasis is given to Project Finance and to the role of MDB. Cost-Benefit Analysis is presented as the general framework to evaluate infrastructure projects, encompassing the financial analysis. Funding options are discussed and this chapter ends with some general trends for the future;

Chapter 4 enumerates the different possibilities for private sector involvement in the provision of public services, details PPP highlighting the main differences to traditional public service delivery. Particular attention is given to the theory supporting PPP, reviewing the literature on the field;

Chapter 5 is focused on the Portuguese experience with PPP, starting with the legal and institutional framework and then, describing four of the major transport projects, with a brief note on the PPP health programme. Concerning the operational performance, a model is proposed to assess the relative performance of the SCUT concessions using Data Envelopment Analysis;

Chapter 6 is dedicated to the empirical analysis of the determinants of the private sector and of MDB participation in PPP arrangements to developing countries. Related to this analysis, also the determinants of the number of PPP projects and of PPP investments are studied, and of the number of projects with MDB, as well as, of the amounts of support provided by MDB.

Finally, Chapter 7 provides a summary and the main conclusions are drawn.

Chapter 2

Infrastructure and risks

What is infrastructure? This chapter starts presenting some possible definitions of what constitutes infrastructure and their typical characteristics. Infrastructure projects, given their long lives and interrelated parties, emphasize complexity, uncertainty and risk. As such, Section 2.2 pursues with a clarification of the concepts of risk, uncertainty and ambiguity, followed with an overview of the process of risk / uncertainty management developed over the entire life cycle of the project and as a fundamental pre-requisite for success. Lastly, a possible classification of the main risks, typical of infrastructure projects, is presented in Section 2.4.

2.1 What is infrastructure?

In Grimsey and Lewis (2002) words "Infrastructure is easier to recognize than define". In fact, several definitions of what constitutes infrastructure may be found. For instance, the Free Online Dictionary defines infrastructure as "the basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions including schools, post offices, and prisons".[1]

On the other hand, according to the World Bank, "infrastructure is a large-scale technological system, a collection of basic, immovable physical facilities, equipment, and installations, needed to fulfill basic transport, distribution, storage, and processing functions, that is, infrastructure delivers essential public and private services and includes the operational procedures, organization, and management needed to make systems function according to their specifications."[2]

[1] http://www.thefreedictionary.com/infrastructure, accessed on March 25, 2011.

[2] http://www.worldbank.org/html/prddr/trans/janfebmar03/box1pg3.htm, accessed on March 25, 2011. Nevertheless, it should be noted that in the World Bank's database of infrastructure projects, only projects in trans-

As noted by Fulmer (2009), common features to nearly all definitions are that they mention or imply the following characteristics: interrelated systems, physical components and societal needs. Therefore, a shorter definition proposed by this author is that infrastructure constitutes "the physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions".

In respect to the classifications available, it is also possible to distinguish between *economic* and *social* infrastructure. *Economic* infrastructure includes highways, water and sewerage facilities, energy distribution and telecommunication networks, whereas *social* infrastructure encompasses schools, universities, hospitals and prisons (Baren, 2009; Wagenvoort et al., 2010).

Moreover, according to Bhattacharyay (2009), a distinction should be made between *hard* and *soft* infrastructure. The former refers to physical structures or facilities that support the society and economy, such as transport (e.g., ports, roads, railways); energy (e.g., electricity generation plants, gas and oil pipelines); telecommunications (e.g., telephone and internet); and basic utilities (e.g., drinking water supply, hospitals and health clinics, schools, irrigation, etc.). The latter refers to operating procedures, management practices, regulatory and institutional frameworks, governance mechanisms, informal and formal channels of communication, and political and social networks. Basically, it refers to all that support the development and operation of *hard* infrastructure.

Another classification for infrastructure projects is the distinction between *greenfield* and *brownfield* projects. *Greenfield* projects concerns infrastructure assets that are build from the beginning, where there are no constraints imposed by previous work and it is not necessary to remodel or demolish any existing structure, they are build in "green" field. By opposition, in *brownfield* projects, the goal is to rehabilitate and improve the existing and badly dilapidated infrastructure assets, that could not easily be privatized or replaced, for instance, water distribution networks or roads.

Apart from the classification criteria and the fact that infrastructure encompasses several different sectors, there are some consensus on the literature concerning their main characteristics

port, telecommunications, energy and water/sewerage are included. Projects in education, health, and other social services are treated separately.

(Bhattacharyay, 2009; Grimsey and Lewis, 2002; Ramamurti and Doh, 2004). Typical characteristics are:

- High development costs;
- Substantial sunk costs because a high proportion of total costs refers to investment in the construction phase, made upfront, before the project becomes operational and starts generating revenues;
- The existence of natural monopolies in infrastructure sectors that exclude competition. In fact, due to the enormous amount of capital required to the construction of some infrastructure assets, the most efficient way to serve consumers, is often to have a single provider (economies of scale). Although, as pointed by Ramamurti and Doh (2004), the technological change can turn natural monopolies into potentially competitive markets, see for instance, the telecommunications sector;
- The assets nature - capital intensive, immobile and not easily redeployed for other uses;
- Non-tradable outputs, that are not possible to be exported or imported, with the exception of energy or telecommunications and just to neighboring countries;
- Political salience - leading to potential problems related to the delivery and pricing of the products and services (that are essential to enhance the populations' living conditions);
- High complexity and uncertainty, given the long lives of these assets and the involvement of numerous stakeholders.

All these characteristics create high barriers to entry and to exit, acting as strong limitations to competition on infrastructure businesses. The lack of competition and the non-tradable nature of the outputs implies that the "invisible hand" of the market do not guarantee the optimal allocation of goods and services, turning government intervention essential to counteract these market failures. This intervention may take several different forms, from direct provider of goods and services (the traditional approach) to just acting as a regulator, a facilitator or a client. The high asset-specificity, typical of infrastructure assets, namely site and physical specificity, makes each project unique and as a consequence, involves large sunk costs that have relatively little value outside that specific transaction. This reality emphasizes the role of long-term contracts and of relational contracting, in what constitutes more complex forms of governance, namely Public-Private Partnerships.

Different studies (Calderón and Servén, 2004; Romp and de Haan, 2005) point to the relevance of an adequate level and quality of infrastructure, as a key ingredient for productivity, growth and development. The basic notion is that "infrastructure matters", although the literature does not report a constant or systematically positive effect on growth (to an overview, see for instance World Bank (1994) or Fay et al. (2010)).[3] In the actual context of a global financial and economic recession, infrastructure as becoming a hot topic in the public debate. A higher rate of investments in infrastructure is seen as an essential stimulus to the economy. At the same time, demographic changes and years of insufficient investment, create pressures for more infrastructure and with a better quality. This is particularly true for developing and emerging countries, that need huge investments in order to support their expanding economies, but it is also true, for developed countries, where the challenge is to upgrade and improve the existing systems. Nevertheless, the financial capacity of the public sector is already overstretched, with high deficits and high debt levels. One possible solution is to involve the private sector in partnerships with the public sector, to obtain new sources of capital. Nevertheless, this is not a miraculous solution, nor even a consensual one, as it will be explored in next chapters.

Infrastructure should be managed and financed in a long-term basis, enhancing the complexity and uncertainty inherent to these projects. Next section attempts to clarify the concepts of risk, uncertainty and ambiguity, that tend to be used interchangeably.

2.2 Risk, uncertainty and ambiguity

Every investment decision is considered as a sacrifice of resources made with an expectation of favorable future returns. Associated to any investment, there is an inherent risk feature related to the uncertainty of the outcome, whether positive or negative. In this first definition of risk, two key aspects are relevant: something that may happen (implies a probability) and that may have a positive or negative impact.

Another definition for risk, from PMBOK (2000) is "an uncertain event or condition that, if it occurs, has a positive or negative effect on a project objective". But although risk and uncer-

[3]For instance, Calderón and Servén (2004), in a relevant empirical contribution, study the impact of infrastructure development on economic growth and income distribution, using a large panel data set encompassing over 100 countries and spanning the years 1960–2000. The most important conclusion reached, is that infrastructure both raises growth and lowers income inequality, becoming an essential ingredient for poverty reduction, moreover, because this effect is more pronounced concerning the low income countries.

tainty, in general, are used as synonymous in everyday life, they meant different things. More precisely, using Knight (1921) definitions, "risk is measurable uncertainty", meaning that it is possible to establish *a priori* statistical probabilities for each of the known possible outcomes; and "uncertainty is unmeasurable uncertainty", when it is not possible to attribute probabilities for each possible outcome or it is not possible to know all potential outcomes, or both the outcomes and the probabilities are unknown.

The issue of decision-making under risk and uncertainty has long fascinated economists. First with the Expected Value Theory, considered in the mid-seventeenth century; next with Bernoulli proposing that people maximize expected utility rather than expected value; and evolving with von Neumann and Morgenstern (1947), turning the Expected Utility Theory (EUT) the dominant approach in the economic analysis of choice under risk and uncertainty.[4] According to EUT, the choice between different alternative courses of action is based on the desirability or "utility" of each action's possible outcomes, weighing those values by their respective probabilities and selecting the course of action that yields the greatest expected utility. In parallel, risk-return models were developed in finance, with the basic assumption that people will try to minimize the level of risk for a given level of return (Markowitz, 1959). The main criticism made to these models, is that the utility of decision outcomes or the risk and return of choice options are determined entirely by the "objective value" of possible outcomes and the wealth they generate. Kahneman (2003) emphasizes that the evaluation of outcomes and choice options, however, is influenced by a variety of relative comparisons.

Reinforcing the idea of the necessity of comparability among different choice options, new theories have emerged - the "Regret Theory" (Loomes and Sugden, 1982) and the "Prospect Theory" (Kahneman and Tversky, 1979). In the Regret Theory, decision-makers try to maximize expected utilities and simultaneously minimize the net regret, defined as the difference between what was received and what could have been received with a different action under the same state of the world. Feelings of regret or rejoicing (if the realized outcome is better than the alternative) affect the choices made by decision-makers. Usually, feelings of regret are stronger than feelings of rejoicing, as cited by Weber and Johnson (2009). Prospect theory is a descriptive theory that, in contrast to EUT, measures relative losses and gains, as changes from a reference point, and not the absolute wealth. The value function is normally concave for gains (risk aversion), convex for losses (risk seeking) and is generally steeper for losses than for gains indicating that there is a bigger impact of losses than of gains (loss aversion).

[4]For more details on the historical perspective see, for instance, Weber and Johnson (2009).

All the models presented above, are models of decision under risk, when probabilities can be assigned to different outcomes. But uncertainty refers to situations where no probabilities can be attached to possible outcomes. Nevertheless, models have been proposed which imply that all uncertainties can be reduced to risks, at the very least by simply applying the principle of insufficient reason (principle of indifference) and treating the unknown probabilities as though they were known to be equal. However, in the real life situations, decisions are made without explicit knowledge of probabilities, under conditions of "ambiguity".

With Ellsberg (1961) renewed interest in the problem of decision under uncertainty as emerged. Ellsberg (1961) showed that people clearly distinguish between risk and uncertainty in what was known as the Ellsberg' Paradox. The simplest example, known as the "two-color" problem, may be explained as follows: consider two non-transparent urns, each containing red and black balls. The first urn has 50 black balls and 50 red balls. The second urn also has 100 balls, but with a mixture of black and red balls that is unknown. People are asked to choose an urn to draw from, and bet on the color that will be drawn - they will receive a $100 payoff if that color is drawn, and $0 if the other color is drawn. They must decide where to bet on:

1. A red draw from Urn I or a black draw from Urn I
2. A red draw from Urn II or a black draw from Urn II
3. A red draw from Urn I or a red draw from Urn II
4. A black draw from Urn I or a black draw from Urn II

For the first two options, people are indifferent because the odds of winning are the same in both urns. But in cases 3 and 4, people uniformly prefer a draw from Urn I, in what constitutes a paradox. Because if people consider a draw of a particular color from Urn I as more likely, than otherwise they would not choose Urn I in both cases 3 and 4. Choosing Urn I in case 3, means that people believe (rightly or wrongly) that Urn II has more black balls than red. But if that is their belief, then they ought to choose Urn II in case 4. This example illustrates that a majority of decision makers when confronted with a choice between a risky option and an uncertain one, choose the risky option, exhibiting ambiguity aversion.

People's actions in presence of uncertainty depends not only on the perceived probability of the event in question, but also on its vagueness or ambiguity (Fox and Tversky, 1995). These considerations provide evidence against the validity of EUT.

If we are comparing two events with different levels of knowledge, the contrast makes the less familiar bet less attractive. Fox and Tversky (1995) reinforce the comparability aspect, meaning that ambiguity aversion will be present when subjects evaluate clear and vague prospects jointly, but it will greatly diminish or disappear when they evaluate each prospect in isolation (comparative ignorance hypothesis). In the same line of research, Chow and Sarin (2001) argue that the complete disappearance of ambiguity aversion, in a non-comparative condition, may not be as robust as initially Fox and Tversky (1995) had supposed. The main conclusion is that the clear bet is priced higher than the vague bet under both comparative and non-comparative conditions. In a comparative condition the knowledge difference between the known and the unknown bet becomes more relevant and by contrast, in the absence of a direct comparison (non-comparative condition) this difference is smaller, but it does not disappear.

Ambiguity aversion has received much attention since Ellsberg's seminal work, mostly because, decision makers usually do not know the precise probabilities of potential outcomes in real life situations. As Zeckhauser (2006) emphasizes, in the real world of investing, the widespread situation is "ignorance", where not even the possible states of the world are known. As a summary, the knowledge about the probability distribution of possible outcomes, can lie anywhere on a *continuum*, as illustrated in Figure 2.1.

Figure 2.1: *Continuum* of knowledge about outcomes and probabilities

Ambiguity concepts have been incorporated in several research fields, but finance is probably the research area with more applicability. A large and growing literature had appeared incorporated ambiguity aversion in the explanation of observed market anomalies, regulatory recommendations and investment strategy (for more details, see for instance, Kocher and Trautmann (2010)). Some examples include applications of ambiguity to financial regulation and investment behaviour (Easley and O'Hara, 2009; Zeckhauser, 2006), emphasizing the effect of ambiguity aversion on self-selection and market size.[5] Yet, Bossaerts et al. (2010) study the impact of ambiguity on portfolio holdings and asset prices.

A related concept is risk and uncertainty management, critical to all projects and particularly, for large infrastructure projects.

2.3 Risk and uncertainty management

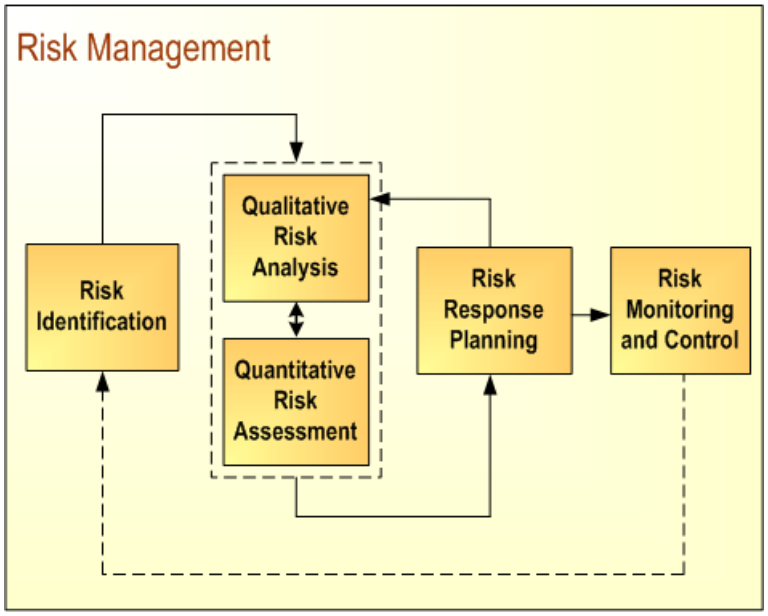
Traditionally, risk management has been defined as a global approach to minimize or eliminate adverse consequences of risk to a project or organization. More precisely, a risk management system includes policies, procedures and practices that aims to identify, analyze, evaluate, mitigate and monitor risk. A formal risk management process should be applied at all stages in the project life cycle and managing risk is an ongoing process, involving all the stakeholders, although the risks' nature will change as the project evolves.

As mentioned in Chapman (1997), implementing procedures for risk management earlier in a project life cycle is, undoubtedly, more complex and difficult, but this is compensated with the higher benefits that may result from improvements in the project plans and from opportunities that can be captured in initial stages of the project. By contrast, implementing risk management routines, later in a project life cycle, face particular challenges, namely "contracts are in place, equipment has been purchased, commitments are in place, reputations are on the line and managing change is comparatively difficult and unrewarding".

[5]Investors that are ambiguity averse, shy way from markets for ambiguous investments, leading to reduced competition and lower prices. This effect of selection between different market segments is an important aspect by which ambiguity affects market outcomes.

Chapman (1997) developed a generic process for project risk analysis and management with a detailed nine-phase structure. But, as mentioned in his work, other specific risk management processes, with more or less detail, can be considered equivalent. Figure 2.2 shows the generic steps in any risk management process.[6]

Figure 2.2: Risk Management Process



Source: JISC - infoNet

The four main stages of the risk management process are:

- **Identification** - For each project it is critical to identify areas of risk. For instance, as a starting point, it may be relevant to focus on the project plan, the main stakeholders, the resources available, the organizational environment and the external environment. Typically, large and complex infrastructure projects with a long tenor, are particularly exposed to changes in the external environment that may affect the normal project development. To mention just a few possibilities, we may consider: changes in government, new legislation affecting environmental issues, changes in the demand patterns for particular services, economic recession. In this phase, it could be useful to distinguish between generic risks that are common to all projects, from specific risks, inherent to the nature of the project that is being developed. It is possible to use a checklist for risk identification but it is always necessary to think about what is "unique" in that project.

[6] Available on http://www.jiscinfonet.ac.uk/InfoKits/risk-management, accessed on March 15, 2011.

- **Analysis and Assessment** - In order to focus our attention and resources in the most serious risks, it is necessary to prioritize risks. To access the risk relevance, it is usually considered two parameters: the probability - the likelihood of the risk occurring; and the impact - the consequences if the risk does occur. The impact could be measured in terms of time, cost and quality. Another relevant feature is the risk proximity. Although, there is a natural tendency to focus on immediate risks, that sometimes it is too late to avoid or mitigate, attention should be devoted to risks that have a larger horizon and could be effectively manageable.

  If the risk identification and assessment show more serious risks than had been anticipated, a serious judgement must be developed about the viability of the project. Sometimes, it will be necessary to review the initial business case and to explore different options.

- **Response** - General types of response to risk, according to the PMBOK (2000), include:
  - **Avoidance** - is changing the initial project plan so that the circumstances which may give rise to the risk no longer exist;
  - **Transference** - is the transferability of the risk to other entity;
  - **Mitigation** - is to take actions to lessen or reduce the impact or the probability of the risk;
  - **Acceptance** - dealing with the risk, creating contingency plans.

  The transference and acceptance of risks constitutes a more general process called "Risk Allocation".[7] The general principle to be followed is that, for each risk associated with the project, it should be transferred to the party best positioned to deal and manage it.

- **Monitoring and Control** - The final phase is to continually monitor the identified risks and the effectiveness of risk responses. As an ongoing process, attention should be given to changes on the probability and impact of the risks under consideration, to the identification of new emerging risks, and to remove risks that have passed. To accomplish that, effective reporting mechanisms should be applied.

[7] The optimality of risk allocation is a cornerstone of Public-Private Partnerships, as it will be explored in Chapter 4.

What has been presented in this section, until now, constitutes the traditional approach to risk management. But a new trend has emerged, that incorporates recent literature developments. Ward and Chapman (2003) argue that project risk management should be changed to project uncertainty management, given that "risk" is usually related to adversity, threats to the project, affecting its performance. This narrow view is a very restrictive approach. Opportunities should also be considered in the analysis and therefore, uncertainty management will encompass not only the negative impacts on project outcomes, but also the changes that may be seen as opportunities. Besides this larger scope achieved, managing uncertainty is also identifying and managing the sources of uncertainty, aspects of extreme relevance for the earliest phases of the project life cycle, when uncertainty is at its maximum value.

In the same line, Perminova et al. (2008) emphasize the role of uncertainty in projects. They argue that traditional project management and risk management processes are, in essence, detailed action plans, that must be followed in order to achieve the main goal of the project - to deliver a product or service according to the clients' specifications and meeting the three basic criteria of time, cost and quality. This is not enough to deal with uncertainty, defined as "an event or situation, which was not expected to happen, regardless of whether it could have been possible to consider it in advance". As such, planning is necessary, but not a sufficient tool in managing risks and uncertainty. In this respect, new tools are gaining relevance such as information sharing, reflective learning and accumulating knowledge. As each project is considered a unique endeavor, the main risk is that all the experience and knowledge gathered in the project development will be lost, after its conclusion. Nevertheless, each project is unique, only to a certain extent. Experience and knowledge, can and should be used, in other projects, for instance through the standardization of successful procedures. The creation of a system of lessons learned and sharing information and knowledge, will enhance flexibility and will turn uncertainty more manageable.

But what kind of risks and uncertainties are typical of infrastructure projects? Next section is devoted to explore this topic.

2.4 Classification of risks

Possible risk classifications abound in the literature. For instance, Trujillo del Valle (2004) classifies infrastructure risks in four categories: political, legal, financial and project-specific, yet Tinsley (2000) examines the structures and risk mitigants of fourteen classes of risk and Lemos et al. (2001) classifies the risks in twelve different classes for projects developed under the Private Finance Initiative. As a summary, the following risks are considered: sponsors, design and construction, operational and maintenance, political, legal, market, environmental and social, and *force majeure*.

Sponsors risk - refers to the sponsors' financial strength, technical competency and experience in similar projects, according to Tinsley (2000). Naturally, projects will benefit from previous sponsor relationships and knowledge acquired in former businesses.

Design and construction risks - arise when it is impossible to complete a project on-time, on-budget and it is unable to perform as planned. Risks due to engineering and design failures or construction problems, originating delays and cost overruns. Usually, these risks are not supported by lenders and are a sponsors' responsibility, which in turn, use turnkey contracts to allocate these risks to constructors.

Operational and maintenance risks - occur when a project does not operate as planned or costs more than expected to operate at an agreed capacity or efficiency. Following Nguyen (2002), strategies to mitigate these risks include: allocating the risks to operators through specific contracts, conducting technical studies using tested and proven technologies, obtaining cost guarantees and technology insurance, and having experienced management.

Political risk - includes the risks of expropriation, currency convertibility and transferability, and political violence, such as war, sabotage or terrorism. Matsukawa and Habeck (2007) argue that risks "that arise from the actions or inactions of the government that adversely affect the operation of a private company engaging in infrastructure business", should also be included. For instance, breach of contract, change of law, taxes or incentives and frustration of arbitration.

Legal risk - is related to the degree to which creditors have legal rights and can rely on local enforcement, using the definition proposed by Esty and Megginson (2003).

It should be emphasized that infrastructure projects are particularly affected by political and legal risks, furthermore, if the project is developed in an emerging country. The main characteristics of these projects, like heavy up-front investments, long contract periods and the fact that they provide services which are essential to the communities, make them more prone to these risks. Political and legal risks can be minimized by obtaining government guarantees and through the participation of multilateral development banks in these projects, e.g., the World Bank or the European Bank for Reconstruction and Development.

Market risk - deals with the possibility that fluctuations in demand and changes in the prices of inputs or outputs may not cover all the costs of the project and full repay the debt. Market risk includes *interest rate risk*, *inflation risk* and *foreign exchange risk*. This last one, appears with a mismatch of the currency of the operating costs, revenues and the debt. Also included here, and of critical importance for the viability of any infrastructure project, is *demand risk* - the risk that the demand for the service does not correspond to the level expected. This risk is of particular relevance for transport projects. Many of the unsuccessful stories in this sector, have resulted from overoptimistic traffic projections, that do not materialize in the operational phase (Estache et al., 2007). It should be noted that for this kind of projects, differently from other infrastructure sectors, it is not possible to establish from the beginning contracts with the clients. Market risk can be managed in several ways: hedged through proper financial derivatives,[8] making detailed market projections and lastly, using contractual agreements with suppliers or output buyers - obtaining take-or-pay agreements and long-term sales contracts (when possible).

Environmental and social risks - refer to possible adverse environmental and social consequences of the project. In recent years, the environmental impact of a project plays an important role in deciding whether a project can proceed or not. Although for many years this kind of risk was not an issue, specially in third world countries. The adoption of the *Equator Principles* by many lending institutions, in 2006, is a clear sign of the importance of adopting responsible environmental and social policies. The *Equator Principles* are a voluntary set of guidelines for managing social and environmental issues related to the financing of development projects. The financial institutions only provide loans to projects developed "in a manner that is socially responsible and reflect sound environmental management practices" (Equator, 2006). As a strategy to mitigate these risks, sponsors should make detailed environmental studies, obtain all the necessary environmental licenses and also, use private insurance.

[8] Although these instruments are not always available in emerging markets, where, for instance, foreign exchange risk is more likely to occur.

Force majeure risk - results from events that are beyond the control of the parties involved in the project and for that reason, exempt the parties from legal consequences of non-performance, according to Nevitt and Fabozzi (2000). Examples are natural disasters such as fire, flood or earthquake, although the scope of this risk is hard to define. Private insurance is usually the option available to prevent this kind of risk, but hardly it will cover all the contingencies.

As already mentioned, earlier project phases are mostly characterized by uncertainties, and as the project matures, these uncertainties are transformed into risks. In respect to the type of risk, the design and construction phases are particular exposed to delays in completion, cost overruns, insolvency or lack of experience of contractors or key suppliers, and environmental or social problems (Estache et al., 2007). As the project evolves and starts the operational phase, more exposed will be to market and political risks.

Concerning developing countries, more serious risks may arise related to the unavailability of materials or equipment for construction and operation, and in addition, foreign currency fluctuations can cause a significant increase in costs. In parallel, the mechanisms available to mitigate or hedge the risks, face severe limitations. In practice, in most emerging countries, difficulties may appear due to market imperfections, for instance, derivative markets not sufficiently developed, limited contracting possibilities due to the legal and regulatory framework and different methodologies for risk measurement and evaluation, among other factors.

A synthesis of the previous risk classification is presented in Table 2.1.

Table 2.1: Risks and mechanisms of mitigation

Risk	Definition	Mechanisms of mitigation
Sponsors	related to the technical competency, financial strength and previous experience of the sponsors	experienced sponsors
Design / / Construction	when it is impossible to complete the project as originally envisaged due to engineering, design or construction failures	risk allocation to the constructor through turnkey contracts
Operational / Maintenance	when a project does not operate as planned and have higher operating and maintenance costs	risk allocation to operators through contracts; technical studies using tested and proven technologies; cost guarantee and technology insurance; having experienced management.
Political	risks of expropriation, currency convertibility, transferability and political violence; risks that result from the actions or inactions of the government that adversely affect infrastructure businesses	obtaining government guarantees; participation of multilateral development banks and export credit agencies
Legal	related to the degree to which creditors have legal rights and can rely on local enforcement	obtaining government guarantees; participation of multilateral development banks and export credit agencies
Market	when possible variations in price and quantities of inputs or outputs may not cover all the costs of the project and full repay the debt: Foreign exchange, interest rate, inflation and demand risks	hedging using proper financial derivatives; making detailed market projections; contractual agreements (with suppliers or output buyers - obtaining take-or-pay agreements and long-term sales contracts)
Environmental / Social	adverse environmental and social consequences of the project	to obtain previously environmental licenses and permits, private insurance
Force majeure	events that are beyond the control of the parties and that exempt the parties from legal consequences of non-performance (e.g natural disasters, wars)	private insurance

Any infrastructure project is a long term and complex endeavor. Furthermore, development of infrastructure assets requires large amounts of financial resources and face a lengthy gestation period. What are the possibilities to finance such projects ? Next chapter is focused on the topic of infrastructure finance.

Chapter 3

Infrastructure finance

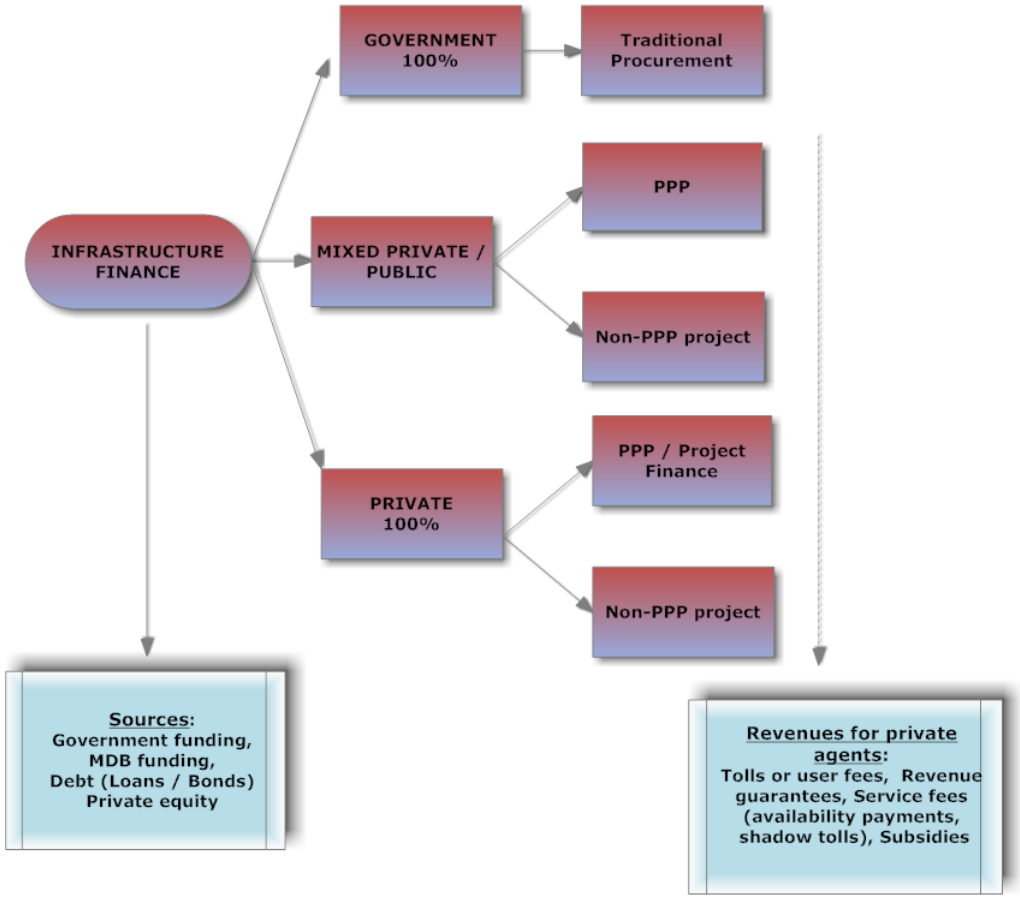
All around the world, infrastructure needs are growing rapidly far exceeding the public resources and other traditional sources of financing available, in what is called the "infrastructure gap". This fact constitutes a strong motivation, if not the *main* motivation, for the involvement of the private sector in businesses that once were a government exclusivity. The private sector involvement can assume different formats but for infrastructure projects, Public-Private Partnerships (PPP) are usually the option chosen. This chapter begins with a presentation of the sources of infrastructure finance. Section 3.2 details Project Finance, as a privileged funding mechanism for infrastructure projects. Section 3.3 explains the fundamental role of Multilateral Development Banks (MDB) and similar agencies in supporting infrastructure projects, role emphasized particularly in times of financial distress. Section 3.4 provides the general framework where the financial features should be analyzed, comparing financial viability with economic viability. Next, the controversial issue of who should pay (and therefore, finance) infrastructure assets and services is addressed in Section 3.5. Finally, Section 3.6 draws some prospects for the future.

3.1 Sources of infrastructure finance

In a first classification, finance for infrastructure can arise from public or private sources. In the past, the government assumed this responsibility with the majority of projects being developed under traditional procurement methods, fully financed with public resources. From the second half of the 20th century onwards, a new phase emerged with privatizations and new regulation models appearing from the new roles attributed to the State, making Public-Private Partnerships (PPP) and others forms of private sector involvement more frequent in infrastructures businesses. PPP are long-term cooperation agreements between the private and public sector

for the provision of an asset or service. Note that in most PPP, finance is entirely private. In addition, a PPP scheme may use Project Finance (PF) techniques or not. In PPP with PF, the private agents rely exclusively on the assets and cash-flows of the project, to pay the debt and to provide returns to investors, while in others PPP, private agents can obtain revenues guarantees or service fees from the public partner. An arrangement to be considered a PPP, should have at least the following main characteristics: long-term horizon, bundling of different project phases, risk sharing between the public and private partners and private finance. Different possibilities exist for private sector involvement beyond PPP. Hence, other mixed situations concerning financial sources, may appear. A breakdown between public and private finance is illustrated in Figure 3.1.[1]

Figure 3.1: Composition of infrastructure finance



[1]PPP are further explored in Chapter 4 and PF is detailed in next Section 3.2.

Any infrastructure project is financed with two types of capital, debt and equity, similarly to other kinds of projects. Three general categories of capital and loans are used: equity, subordinated debt (also called mezzanine financing or quasi-equity) and senior debt that usually are secured or asset-backed. The proportion of capital that a sponsors commits to the project - the equity - has no upside or downside limit (in case of distress, losses could achieve 100%). Equity investors are the last in priority for repayment. Concerning debt, while the downside is unlimited (also to the full extent of the amount lent), the upside is limited to the rate of interest charged on the loan. Typically, given the risks, maturities and amounts involved, project debt has higher spreads than corporate debt. The senior debt usually is the largest part of the financing (more than 50% of the total) and are provided by commercial banks, being the first debt to be placed (Nevitt and Fabozzi, 2000). This debt is not subordinated to any other liability, meaning, that it is first in priority of payment. There are also subordinated loans, that assume a secondary position concerning the priority of payment and usually have a higher rate of return as a reward to the higher risk level. These loans are long term, unsecured and may be considered as equity by senior lenders.

Nevertheless, unlike other kinds of projects, infrastructure projects exhibit particular characteristics that influence the source of the financial resources to be used. Infrastructure finance usually has the following characteristics: longer maturities (ranging from 5 to 40 years), larger amounts, higher risk and uncertainty, but at the same time exhibit stable returns (Mor and Sehrawat, 2006).

A wide range of funding sources are available to finance an infrastructure project:

- Government funding (grants, loans, credit enhancement) and direct investment;
- Commercial banks that are the largest source for project loans, typically arranged as syndicated bank loans;
- Multilateral and bilateral agency funding (MDB and export credit agencies);
- Other institutional investors (e.g., life insurance companies or pension plans);
- Capital markets;
- Securitization;
- Project Finance.

Projects have extremely high debt levels (mean debt of 70%). Although, according to Nevitt and Fabozzi (2000), there is an usual misconception that project financing involves little or no equity investment by the owners or sponsors of the project. Effectively, lenders only provide funds to projects where the sponsors have enough money at stake to guarantee the proper motivation and commitment level, therefore, ensuring the efforts to a successful conclusion. In fact, the appropriate level of the debt to equity ratio of a project is the result of the negotiation process between the sponsors and the lenders.

In this respect, Esty (2003a) explains that high leverage levels are justified to infrastructure projects, usually structured in a Special Purpose Vehicle (SPV), because high debt levels provide a governance mechanism and prevent agency costs. In a SPV, agency costs of equity (managerial discretion, expropriation) are high and agency costs of debt (debt overhang, risk shifting) are low due to less investment opportunities.

Considering the type of debt, bank loans are the preferred form of external finance, because are cheaper to issue, allow better monitoring and are easier to restructure during distress.[2] According to Sorge (2004), international syndicated bank loans accounted for 80% of total project debt flows, over the period 1997-2003, and to a lesser extend, bond markets were used. Although the volume of capital raised through international project bond markets remains relatively small, the market has gained maturity during the 1990's. For instance, Esty and Christov (2002) pointed that from 1997 to 2001, project bonds grew almost three times faster than project loans, despite the Asian crisis and the economic slowdown. The emerging project bond market is particularly interesting to institutional investors, such as insurance companies and pension funds, whose long-term liabilities match the long-term tenor of project bonds. The Ras Laffan Liquified Natural Gas project in Qatar represents a milestone in this respect with its $1.2 billion bond offering completed in December 1996 (see Dailami and Hauswald, 2007). Nevertheless, in a more recent statistical overview of infrastructure investments, Esty and Sesia (2007) point that in 2006, bank loans still accounted for 86% of the total debt raised by project companies, trend that still is maintained. Wagenvoort et al. (2010) mention that for the European countries, considering the years of 2006 to 2009, on average, about 80% of a project is funded by loans.

[2]Typically, given the long life of the project, restructuring and renegotiation of the deal will occur and it will be easier to work on a solution with a small group of banks, rather than, with a large number of bondholders. Additionally, a more concentrated debt ownership structure will increase the benefits of monitoring and as showed in Dewatripont and Legros (2005), projects financed through a few intermediaries are likely to perform better than others.

Loans and bonds tend to be long-term credits and concerning loans, they are usually provided by a bank syndicate. A syndicated loan is a large loan in which a group of banks jointly offer funds to a borrower firm. Members of the syndicate are classified as "lead arrangers" or "participants". The lead arranger establishes and maintains a relationship with the borrower firm, negotiates the credit contract, namely the terms of the loan - principal, interest, maturity, collateral and guarantees an amount for a price range. Typically, the participant lenders do not directly negotiate with the borrowing firm and is the lead arranger, who takes the responsibility for arranging the deal, attract other banks as participants, conduct due diligence and monitoring the performance of the borrower firm.[3]

Loans are priced at a fixed spread above a benchmark interest rate, usually the EURIBOR or LIBOR, and bonds carry a spread above a comparable risk-free government security. However, spreads are only one component of the economic cost of a syndicated loan that the borrower has to pay, with the rest corresponding to a variety of fees: arrangement fee, participation fee, commitment or facility fee and agency fee. Some fees are usually charged during loan syndications, others are paid during the whole lifetime of the loan. Bonds also carry fees, but they tend to be paid up front and are mostly related to issuance costs.

From a lender's perspective, the pricing of loans and bonds should reflect the riskier nature of infrastructure investments. Particularly, risks that are not possible to allocate to the best party positioned to deal with each of them and project-specific risks that are difficult to diversify. To overcome these drawbacks, Sorge (2004) mentioned that lenders are making increasing use of innovative risk-sharing structures, alternative mechanisms of credit protection and new capital market instruments to broaden the investors' base. Concerning credit protection, financial institutions are using credit derivatives, new insurance products against macroeconomic risks and political risk guarantees. Others possibilities include the use of real options and the securitization of project loans.

Besides loans and bonds, infrastructure funds have become available to a large pool of investors, appearing as a new source of private finance. These debt investors are typically, institutional investors such as pension funds, which intend to match their long-term obligations with the long dated and stable income flows offered by these assets, but also, retail investors. It is now

[3]For more details on the role of the lead arranger, see for instance Gatti et al. (2008) or Sufi (2007).

recognized that infrastructure funds are a good option, comparing to investments with the same risk, like bonds or real estate, being a stable asset class which offers long tenors and relatively higher yields. In addition, infrastructure is often classified as a "defensive" asset, exhibiting low correlation with more traditional equity assets. This is an attractive feature if the investor goal is portfolio diversification.[4]

Infrastructure has some common features with real estate, namely, heavy up-front investments in construction, operating costs that are relatively predictable and the assets' long life, providing stable yields. But also exhibit some relevant differences - the assets are often natural monopolies with a large costumers' base, giving rise to the need of regulatory control. Also, projects have strong cash-flows, extensive government involvement, a large environmental effect and broader dependencies with the economic and social context.

Exploring this topic, Dechant and Finkenzeller (2010), perform an empirical study to compare investments and the role of real estate in a multi-asset portfolio when alternative assets are considered, namely, infrastructure. Because infrastructure has similar underlying characteristics to real estate, it is expected that both assets offer identical diversification benefits inducing investors to face a trade-off between both asset classes. The results confirm that infrastructure is an important asset for portfolio diversification and moreover, that theoretical allocations to real estate are probably overestimated when infrastructure is not considered. Notably in down markets, both assets constitute attractive investments for downside risk averse investors.

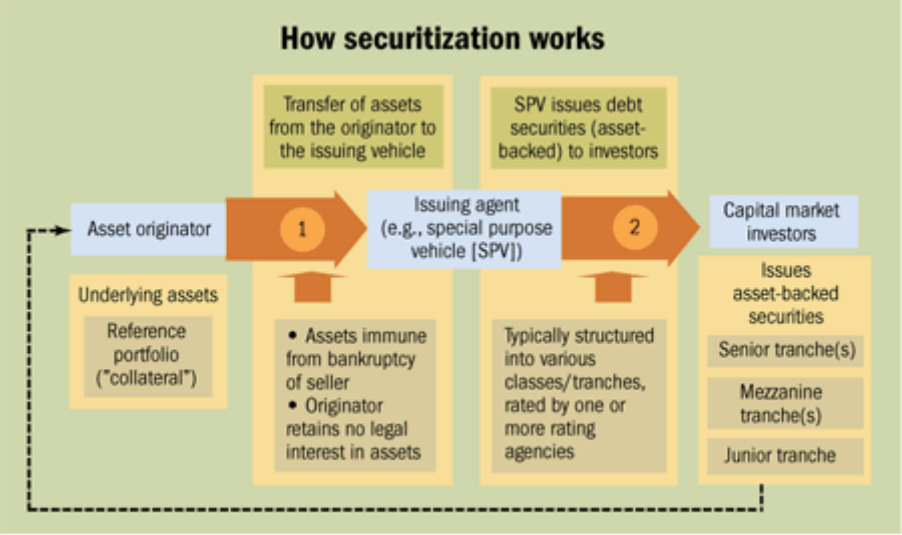
Innovative funding techniques, such as securitization, are of critical importance to attract private investors. Initially, the lack of accurate data on project default rates, recovery timings and losses, turned securitization a difficult task. Nevertheless, as more data has becoming available confirming that infrastructure loans have better performance with higher recovery rates when compared with other corporate loans, and at the same time, the rating agencies start to elaborate rating methodologies, the securitization option of infrastructure loans has moved from just a possibility to a reality.

The suitability of securitization for infrastructure funding may be explained by the fact that cash flows are stable and concession driven, and also because in essence, credit risk is partly guaranteed by government (see Forrester, 2000, 2001). Securitization applies equally to a single

[4]More details available on Singh et al. (2006).

project loan, as well as, to a diversified pool of loans. Good candidates are syndicated infrastructure loans, given their amount, long tenor and risk profile. Securitization involves two different phases, as next Figure 3.2 highlights.

Figure 3.2: The process of securitization



Source: Jobst (2008)

In the first phase, the company or financial institution (originator) pools the assets into what is called the reference portfolio. This collection of assets is typically a group of small and illiquid assets that are unable to be sold individually. Next, this asset pool is sold to an issuer, such as a SPV. In phase two, the SPV finances the acquisition of the pooled assets by issuing marketable securities that are sold to capital market investors. At the same time a trustee account is created, funded by the cash flows generated by the reference portfolio (revenues generated by the projects), providing payments to investors. It should be noted, that usually, the originator services the loans in the portfolio, collects payments from the original borrowers, and deliver them directly to the SPV or the trustee, being compensated by a servicing fee (Jobst, 2008).

In a more recent sophistication, the reference portfolio is divided into different classes, called tranches, each of which has a different level of risk associated with it and is sold separately, allowing different risk/return profiles that match the risk appetite from the investors. In the end, the result will be different creditors with varying degrees of seniority, where more senior creditors will be paid first in case of bankruptcy (senior debt tranche) and only if there is remaining money, the next most senior tranche will be paid, and so on, in a “cascade waterfall”.

The main advantages of securitization arise from the possibility of risk diversification, enhancement of the sources of funding where illiquid assets are converted into marketable securities and facilitates financial institutions to comply with the requirements of regulatory capital, because initially, no capital reserves were necessary to cover highly rated securitized debt. As explained in Jobst (2008), the assets are removed from the originator's balance sheet, improving the credit rating what allow issuers to raise funds more cheaply than would be possible on the strength of the originator's balance sheet alone. Moreover, unlike conventional debt, securitization does not inflate a company's liabilities. Instead it produces funds for future investment without balance sheet growth.

In essence, all the assets that present a stable cash flow pattern can be transformed into a marketable debt security. Under the generic name of asset-backed securitization (ABS), it is possible to find a variety of underlying assets: mortgages, project finance loans, corporate and sovereign loans, consumer credit, lease/trade receivables, and individualized lending agreements.

It should be noted that the current financial crisis has been, in part, attributed to the securitization of debt and some misconceptions concerning the underlying risk. The securitization experience has began around the 70's, with apparently only positive effects. Nonetheless, with the debt crisis that started in 2007, the demand for lending money either in the form of mortgage bonds or collateralized loans obligations (CLO - the securitization vehicle for loans) had almost stopped. However, the eventual return of CLO appear to be very important, as they are the primary mechanism by which syndicated and leveraged loans can be sold to other investors besides banks.

More recently, some signs of recovery are evident. In an article from *Institutional Investor* (November 2010), it is mentioned that the European ABS market is returning to life, although restricted to few countries, "credit terms are much stricter, with investors demanding that the cushions for losses, known as credit enhancements, be much larger than in past transactions". In addition, because of new capital rules, banks have to keep securitized transactions on their balance sheets: "in the last decade securitization was more about capital relief as much as funding, but there's no doubt that the pendulum has swung in the direction of funding".[5]

[5]http://www.institutionalinvestor.com/article.aspx?articleID=2717366 accessed on April 18, 2011.

Summing up, it is obvious that there is a huge gap between investment demand for infrastructure and financing supply. And although, the traditional modes of financing, through banks and financial institutions, raising funds from the domestic capital markets and also foreign direct investment would continue, more and more pressure on governments will lead to a continuous search for alternative ways of financing these investments. In this respect, Project Finance appears as a potential solution, issue that will be explored in next section.

3.2 Project Finance

There is no single and precise definition of Project Finance (PF). For instance, Esty (2004) defines it "as the creation of a legally-independent project company financed with non-recourse debt for the purpose of investing in a capital asset, with a single purpose and a limited life". The non-recourse nature means that project own assets and cash flows are the sole source to meet financial obligations and to provide returns to investors.

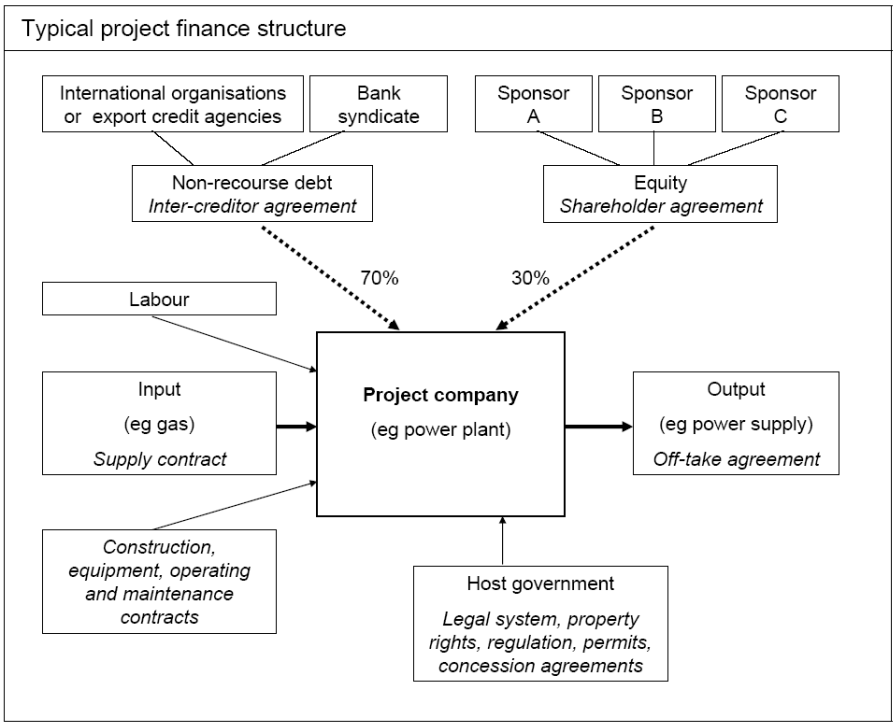
Besides non-recourse debt, PF may imply limited recourse debt. In this last situation, for some period of the project life (e.g., until construction is complete or another milestone is achieved), lenders have some recourse to the sponsors for repayment. This feature is highlighted by the next definition of Tinsley (2000): "Project financing is an option granted by the financier exercisable when an entity demonstrates that it can generate cash flows in accordance with long-term cash flows forecasts. Upon exercise of the option, the entitys parent(s) or sponsor company(s) balance sheet is no longer available for debt service. The assets, rights and interests of the development are usually structured into a special-purpose project vehicle and are legally secured to the financiers as collateral".

In its modern form, PF was first used on a large scale to develop the North Sea oil fields during the 1970's, where the scale and risk of the investment far exceeded the capabilities of any single petroleum company or even any single consortium of companies, as mentioned in Kleimeier and Megginson (2000). Since then, PF has been extensively used with many success stories, but also, with some financial failures like the Euro tunnel project. The 31-mile link between the UK and France was one of the most expensive projects in the world. The project faced several delays and cost overruns and has become a disaster for lenders (Nevitt and Fabozzi, 2000). PF techniques are now applied across the world, to numerous private and public infrastructure

projects, including power stations, gas pipelines, telecommunication facilities, bridges, tunnels, toll roads, railway networks and more recently, the building of hospitals, education facilities, government accommodation and tourism facilities.

The project companies have structural attributes like high leverage, separate legal incorporation through a creation of a SPV with a finite life (that usually matches the life of the project), highly concentrated debt and equity ownership structures and involve several contractual agreements from input suppliers to output buyers. Project sponsors are usually State-own enterprises, governmental entities with social welfare goals or well known international operating companies, that are joined together through ownership of the SPV and by supplemental contractual agreements. As mentioned by Esty (2003a, 2004), on average, this extensive contractual network involve 15 different parties linked by at least 40 different agreements - PF is sometimes referred to as *Contract Finance*. It should be emphasized that this last feature is critical for the allocation of risks among parties. Figure 3.3 exhibits the typical PF structure.

Figure 3.3: Typical Project Finance structure



Source: Adapted from Esty (2003a)

PF presents several advantages. First, is a new source to raise capital to mega-projects, that otherwise will be outside the reach of even the largest corporations or even governments. Second, the ability to allocate risk to those parties best able to manage them, provided by the web of contractual arrangements is another key advantage, which is pointed in the literature as the main reason for the use of PF, nowadays (Esty, 2002). Other advantages presented by Esty (2003a) are:

- PF is used to protect the corporate balance sheet against risks associated with large projects. In fact, even if the project fails, this would not affect the financial integrity of the sponsor's core businesses, the creation of a SPV prevents risk contamination;
- PF is used as a government system used to prevent agency problems over free cash-flow. Because these projects are prone to high levels of free cash flow, inducing possible managerial mismanagement through wasteful expenditures and sub-optimal investments, PF provides an organizational solution. Therefore, high leverage, joint ownership and the extensive use of contracts are structural attributes of the project companies that discourage costly agency conflicts among participants.

For all the reasons pointed above, PF is much different from corporate finance. In essence, in corporate finance, all the assets of the sponsor company respond to a project default, it is the overall financial health of the sponsor, focusing on balance sheet and cash-flow, that matters. Additionally, given the high ratios of debt-to-equity, lenders may use "step-in" clauses, performing a close monitoring of the management and operations that would be not acceptable in a corporate finance environment. Finally, in PF the organizational and financial structure of the SPV fits one purpose, has a finite life and cannot be easily duplicated, contrary to what happens in corporate finance.

A synthesis of the main differences is presented in Table 3.1.

Table 3.1: Differences between Corporate Finance and Project Finance

Dimension	**Corporate Finance**	**Project Finance**
Financing vehicle	Multi-purpose organization	Single-purpose entity
Type of capital	Permanent - an indefinite time horizon for equity	Finite - time horizon matches life of project
Dividend policy and reinvestment decisions	Corporate management makes decisions autonomous from investors and creditors	Fixed dividend policy - immediate payout; no reinvestment allowed
Capital investment decisions	Opaque to creditors	Highly transparent to creditors
Financial structures	Easily duplicated; common forms	Highly-tailored; which can not generally be re-used
Transaction costs for financing	Low costs due to competition from providers, routinized mechanisms and short turnaround time	Relatively higher costs due to documentation and longer gestation period
Size of financing	Flexible	Might require critical mass to cover high transaction costs
Basis for credit evaluation	Overall financial health of corporate entity	Focus on balance sheet and cashflow
Technical and economic feasibility	Focus on project's assets	Cash flow and contractual arrangements
Cost of capital	Relatively lower	Relatively higher
Investor/lender base	Typically broader participation; deep secondary markets	Typically smaller group; limited secondary markets

Source: Comer (1996)

Although having a larger scope not limited to infrastructure projects,[6] this kind of projects is by excellency, the more appropriate field of application for PF techniques. As a summary of the previous exposition, three reasons support this argument, namely, the ability to raise large amounts of money, the inherent structure of risk sharing among participants, and finally, the financial and organizational structure that fits each project nature, being highly tailored. In addition, for governments, PF techniques are very attractive, because projects must prove to be free-standing, financially viable without recurring to governments funds. While very appealing this last reason, generating more acceptance of the public opinion in an apparent idea of getting "more" infrastructure for free, the reality shows a more complex picture, as the Portuguese PPP cases under study show in Chapter 5.

[6]Other possible applications include, for instance, industrial projects.

In a governments' perspective, the involvement of multilateral development banks and export credit agencies in PPP provides significative support for infrastructure projects, not limited to the financial aspects. Of course, MDB are an important source of funds, but other relevant functions appear, issue that we cover with more detail in the next section.

3.3 The role of Multilateral Development Banks

For infrastructure projects, loans provided by multilateral development banks (MDB) and similar agencies are a critical source of funds. Even more, their participation reduces the perception of risk to the other agents and reinforces the social aspects of the project. In a brief explanation, a MDB is a financial institution, created by a group of countries, that provides financing (long-term loans and guarantees) and professional assistance to developing countries. Typically, the developed countries act like donors and the developing countries are the borrowers. Export credit agencies (ECA) are financial agencies that provide government-backed loans, insurance and guarantees to private firms for their activities abroad. The main goal of ECA is to promote exports and trade from their respective countries. Most industrialized nations have at least one ECA, which is usually a national, public or publicly-mandated agency.

In broader terms, the mission of MDB is to provide financial resources to promote investments that foster development. According to Buiter and Fries (2002), two key characteristics distinguish MDB from other private banks and bilateral donors: first, their multilateral share-holding structure and preferred creditor status, and second, a subsidized capital base and access to other subsidies.

There is an important role of MDB in mitigating the risks of an infrastructure project. Some advantages obtained directly from the MDB participation are: they extend maturities, reduce spreads and through the enhancement of the projects viability, they provide countries with experience in using complex financial structures and dealing with international financial institutions. This last reason also contributes to the development of the local markets and to the strengthening of the host country regulatory framework. Indirectly, such participation acts like a sign to lenders of the creditworthiness of the deal, making fund raising more easy, because projects are subject to detailed appraisals including several financial and non-financial aspects before being approved (see Griffith-Jones and Lima, 2004; Matsukawa and Habeck, 2007).

The involvement of MDB is particularly relevant to developing countries. In order to foster private participation, developing countries should pursue macro-economic stability and improve their institutional framework, namely, strengthening procedures for contract enforcement and dispute settlement and developing a coherent set of policies for trade, tax and competition. In this scenario, the role of MDB is critical, because besides the traditional lending function, important new functions emerge: credit enhancement, mechanism of risk reduction facilitating the raise of private flows and helping governments to perform the necessary reforms. This has been stressed in several works, for instance, Hainz and Kleimeier (2006), Matsukawa and Habeck (2007), OECD (2006), Pessoa (2008), Sorge and Gadanecz (2004) and World Bank (1994).

In this respect, Bhattacharyay (2009) summarizes the main advantages of the involvement of MDB in infrastructure projects - "they can help improve the flow of private savings and capital into infrastructure investments by:

- developing bankable projects,
- designing appropriate, innovative financial instruments,
- assisting countries to enhance their technical capacity and knowledge,
- enhancing financial market depth, efficiency, liquidity, and adherence to international and regional standards or best practices,
- promoting further financial integration."

The group of MDB include the World Bank, the four regional development banks and several other banks and funds. The World Bank started its operations in the aftermath of the World War II with the purpose of lending to poorer countries, using resources from the rich nations. Initially, the financial help was centered in countries ruined by war and later to those in the early stages of economic development (Gurria and Volcker, 2001). Four regional development banks appear with the same goals: the African Development Bank, Asian Development Bank, Inter-American Development Bank and the European Bank for Reconstruction and Development.

The European Bank for Reconstruction and Development was founded in 1991 following the fall of the Berlin Wall and its main focus was to finance investments, mostly private sector

investments, that foster the transition toward open market economies, in the post-communist countries of the former Soviet Union and Eastern Bloc.[7]

With a more restrictive ownership / membership structure and focusing on special sectors or activities, appeared other banks and institutions, that shared the classification as MDB: The European Commission (EC) and The European Investment Bank (EIB), International Fund for Agricultural Development (IFAD), The Islamic Development Bank (IDB), The Nordic Development Fund (NDF) and The Nordic Investment Bank (NIB), The OPEC Fund for International Development (OPEC Fund). In addition, a number of sub-regional banks were also established for development purposes.[8]

Some of the major MDB, namely the African, Asian and Inter-American Development Banks and the World Bank, are oriented to provide loans and grants to governments, in a form of budgetary finance. In exchange for this finance, the borrowing governments commit themselves to implement institutional reforms and to invest in human and physical capital. Instead, the European Bank for Reconstruction and Development and the International Finance Corporation (an affiliate of the World Bank) are institutions more devoted to finance private sector investments.

In the early years of operations, these MDB financed and supported primarily public sector infrastructure projects, through loans, technical assistance and policy-based lending. More recently, in the 1990's, private capital flows faced an exponential increase to many middle-income countries and to some few low-income countries, like China and India. This fact has raised doubts about the role of MDB, particularly in emerging countries. As pointed by Buiter and Fries (2002) and Gurria and Volcker (2001), the episodes of rapid development and economic growth were concentrated in specific countries from East and South Asia, and until now, this growth was not translated into general poverty reduction and enhancement of the population living conditions. As a conclusion, it is argued that the MDB original mission still makes sense for those countries, although it should not be an indefinite task.

[7]Source: World Bank, available at http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/0, accessed on April 27, 2011.

[8]For instance, the Corporacion Andina de Fomento (CAF), Caribbean Development Bank (CDB), Central American Bank for Economic Integration (CABEI), East African Development Bank (EADB) and West African Development Bank (BOAD).

As cited in Gurria and Volcker (2001), the MDB should continue to lend to the emerging market economies, particularly, because: "given the immaturity of their economic and financial institutions, the small size and vulnerability of their markets, and the volatility of global financial markets, access of these countries to private capital can be unreliable, limited and costly for them, exposing them to great insecurity even when their long-run growth prospects are strong" and "lending is a vehicle for policy change and promoting international goals".

In addition, it is emphasized that MDB should expand their private sector operations in a manner that "catalyzes rather than substitutes for private finance", once again, reinforcing the enabling role of such institutions in expanding opportunities for private finance.

But criticisms still remain, namely the delay in obtaining financing from the World Bank (approximately 2 years) and inflexible rules that limit the access of some low-income countries. Additionally, it is argued that the participation of MDB will distort free competition in financing infrastructure projects. The MDB activity will lead to a selection effect, choosing what projects will have access to finance and blocking the access to others (Forrester and Tillett, 1998).

Prospects for the future, emphasize a more selective role of the MDB, focusing on areas not adequately covered from other sources. Recent trends like globalization and a strong shift towards private and market-based approaches lead to an increasing role of the private sector and international finance institutions, as major actors on economic development. At the same time, there is an uneven distribution concerning the access to private financial resources, across countries and regions. As mentioned in Lindbaek et al. (1998), private flows are heavily concentrated on a restrictive number of countries, sectors and borrowers: 75 percent of net private capital flows go to a dozen countries, albeit including the largest developing countries - this leaves over 100 developing countries with little access or none, to private financing.

Thus, while many of the traditional destinations of resources now have access to private finance, there remains a large number of countries which continue to need MDB involvement to mobilize financing. Although a dilemma emerges, since the findings on aid effectiveness suggest that to achieve greater impact, MDB should concentrate financial assistance on countries where policies and institutions are already supportive of development. Usually, these countries are also attractive to private investors. In this scenario, MDB will be pushed towards countries where

the conditions for investment are more difficult, but at the same time will be more selective about investing in these countries where the probability of success is small. As a consequence, investment selection will be reinforced given rise to a more limited range of lending opportunities (Lindbaek et al., 1998).

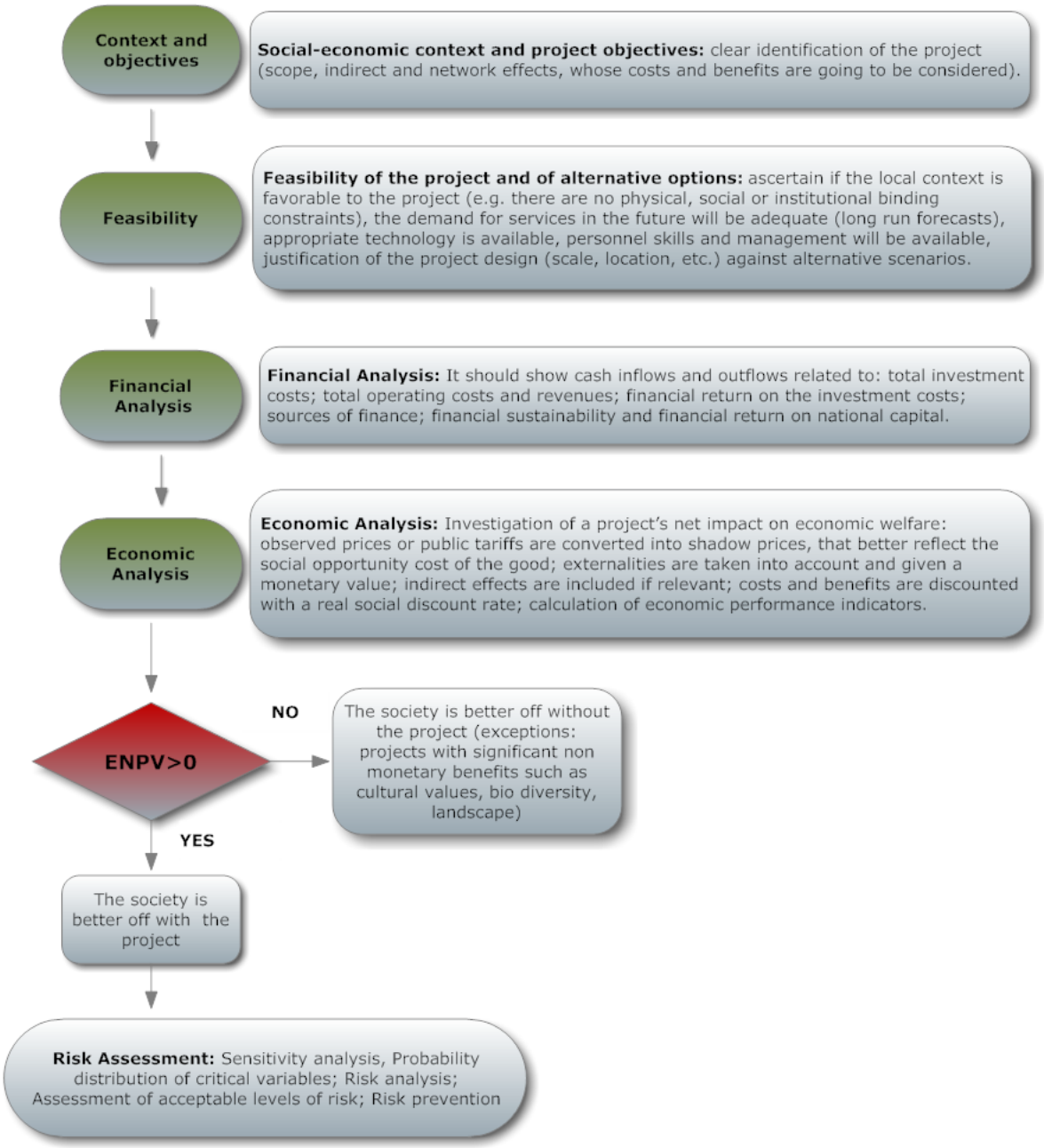
Until now, we are focusing our attention on how to finance infrastructure projects, but a related feature and of critical importance is the discussion about the infrastructure project viability. Moreover, if it is worthwhile from the society's viewpoint, adopting a welfare perspective. Issue explored in next section.

3.4 Financial viability *vs* economic viability

To guarantee the access to the necessary financial resources, any infrastructure project should demonstrate that is economically justifiable. To accomplish that, of particular relevance appear projections of future sales, earnings and cash flows patterns. Moreover, if the project is to be financed with PF, the financial viability of the project is an imperative condition, because project's cash-flows and assets are the unique source to full repay the debt.

At this point, a clarification should be made - any appraisal of an infrastructure project goes beyond mere financial analysis given its intrinsic nature. A more appropriate framework is for instance, Cost-Benefit Analysis (CBA), to assess whether, or to what extent, the project is worthwhile from a social perspective, taking into account all the gains (benefits) and losses (costs) to the society. As mentioned in European Commission (2008), in their *Guide to Cost-Benefit Analysis of investment projects*, CBA is by far, the most commonly used technique when the goal is to evaluate public investment, particularly when European financial support is requested. Nevertheless, other kinds of project analysis exist, like Cost-Effectiveness Analysis, Multi-Criteria Analysis and Economic Impact Analysis, that are used usually as complements to CBA. Figure 3.4 illustrates de main steps in project appraisal using CBA based on the cited guide (European Commission, 2008).

Figure 3.4: The process of project appraisal



Legend: ENPV - Economic Net Present Value

Source: Adapted from EU (2008), *Guide to Cost-Benefit Analysis of investment projects*

Very briefly, a CBA starts with the study of the social, economic and institutional context in which the project will be developed. This assessment is very important, because all the projections of benefits and costs, as well as, the accuracy of the demand forecasts, will depend on the macro-economic and social conditions of the region or country. A clear project identification should be developed including: definition of the project's objectives to assess if the project has social value; clarification of the scope of the project involving indirect and network effects (for instance, diverted road traffic for transport projects), positive and negative externalities should be accounted for; and definition to what extend costs and benefits should be considered, because depending on the geographic level adopted in the appraisal, larger or smaller categories of economic social actors may be affected by the project.

Next step involves the feasibility and option analysis - different options are explored in order to choose the "best" option. As an example if we consider a transport project, options at study may be: different routes, different construction timings or different technologies. The feasibility study aims to identify the potential constraints and related solutions, evaluating the technical, regulatory, economic and managerial aspects. Any project should demonstrate its feasibility to move on to the next phase of financial analysis. Otherwise, it must be abandoned or another option explored.

Concerning the financial analysis, it is still mostly based on discount cash-flow approaches, where the project forecasts of cash-flows are discounted to compute a Net Present Value or an Internal Rate of Return. The time horizon for infrastructure projects is usually of 20 years for this analysis and obviously, never exceeds the economic useful life of the project. The assessment of the investment costs, the operating revenues and costs and the sources of finance, is critical to determine if the project has financial sustainability. The project should demonstrate that it can generate cash (including revenues and any kind of cash transfers) in a timely manner in order to consistently match disbursements year-by-year.

The economic analysis that follows is made taking into account all the effects on the society, instead of just the results to owners or other stakeholders directly involved with the infrastructure asset. In this phase, the main goal is to understand if the project will contribute to the economic welfare of the region or country. To all the costs and benefits should be given a value. The use of accounting shadow prices, based on the social opportunity cost is a key technique and when market values are not available, the effects should be monetized through different

techniques. Sometimes, relevant environmental, social or health effects appear with the development of the project, but they don't have market prices. In such situations, they need to be evaluated and quantified with a realistic monetary value, and included in the project appraisal. As an example, for a transport project, a non-market impact is savings in travel and waiting time, and that can be evaluated by the value of working time savings, meaning, the opportunity cost of the time to the employer, equal to the marginal cost of labor (European Commission, 2008).

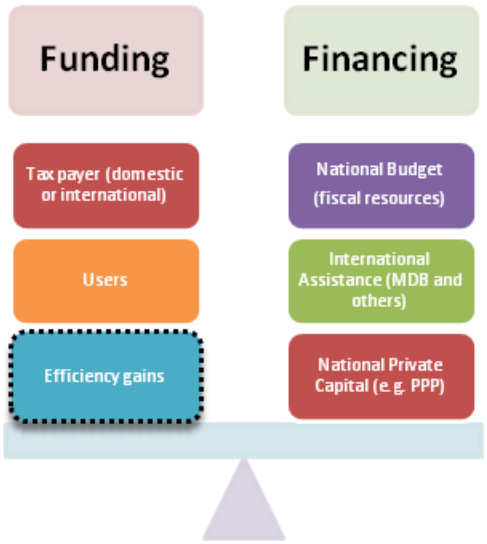
As a result of the economic analysis an Economic Net Present Value (ENPV) will be computed. This ENPV is the most reliable social indicator of CBA and constitutes the main reference for the assessment of the economic performance of the project. It is possible that sometimes, projects that failed on the financial analysis, will now show positive ENPV and with this broader view of the benefits to the society, the project should be developed. The last phase of project appraisal is the risk assessment, topic explored in the previous chapter (see Section 2.3).

Having said that the value of an infrastructure project transcends the financial aspects assuming its nature as a public good and that a broader view is requested encompassing all the economic effects on the society, is now time to answer the fundamental question of who should pay for infrastructure. Next section explores this controversial issue.

3.5 The bottom line: taxes or user fees?

Following the previous discussion, a related topic is answering to the question of who should actually pay for the infrastructure assets and services - taxpayers or users charged with fees? It is important to distinguish between financing and funding of infrastructure. The former is related to the provision of financial capital, by debt and equity that will finance the project, the later is concerned with who actually bears the cost of providing the infrastructure and with the resources that will be used to service the financial capital. Based in Fay et al. (2010), Figure 3.5 highlights the possibilities concerning funding and financing infrastructure.

Figure 3.5: The balance of infrastructure financing and funding



Source: Adapted from Fay (2010)

There is a balance between the funds collected from taxpayers and users and the extend of financing available. This financing is then channelized to infrastructure projects, through national budgets, international assistance and from the private sector. It should be noted that concerning the private sector, their willingness to enter the projects are determined by the possibility of recovery the costs and obtain a reasonable profit rate (supported directly by users or from public subsidies - indirectly by taxpayers). International development assistance will depend on foreign taxpayers.

In parallel, efficiency gains are also an important aspect to be considered in this equation. As explained in Fay et al. (2010), efficiency gains can have different sources, namely, countries may be spending more on some types of infrastructure than they need to and with this, compromising the private sector participation with more innovative and advantageous solutions; reducing institutional obstacles to capital expenditure; reducing delays in infrastructure rehabilitation and improving maintenance that will improve services with a lower cost. All these examples, can help reduce the overall funding (and financing) needs.

What is obvious from the previous figure, is that only two sources appear concerning funding: taxpayers or users. General taxes on wealth, consumption and income are collected by governments in what constitutes the main source of funds to finance public expenditures, in addition

more specific benefit taxes and user fees are imposed on the presumed or actual beneficiaries of the services provided. Economic principles postulate that charging beneficiaries for the costs of infrastructure can be more efficient than to rely on general revenues to fund an infrastructure project. The "user pay principle" means that beneficiaries should pay for the services they benefit and it is a general rule, that applies to most goods and services, although this notion has little support in economic theory when dealing with public goods.

According to Duff (2004), the main rationale to justify user charges is to make government's use of resources more efficient and not specifically, to produce revenue. It is argued that "any society should use its scarce public resources in a manner that will provide its people with as large a bundle as possible of services that they want, and that is all that is meant by efficient resource use." In times of budgetary stringency, to maximize efficiency in the use of scarce public resources, is an imperative. In addition, the imposition of user charges will induce more accountability and market-oriented approaches - if users are asked to pay for a service, they will be naturally more concerned with the availability and quality of the service to be provided.

Albeit the general principle that public services should be payed for, instead of "offered for free", several related issues appeared that are not easy to solve. First, it is not easy to determine the appropriate domain for user charges or to design and implement user charges when they are appropriate. Second, the cost of collecting the fee may exceed its amount, for instance, to implement a system to collect tolls in a road, considering the equipment costs, administrative costs and the related social costs of additional congestion, may lead to the conclusion that such charging makes no sense. Third, new infrastructure is needed partly to meet the requirements of general population increase, and in this situation is difficult to justify why should the users pay for a service that in the past was for free. Finally, user fees are difficult to implement, given the political salience of infrastructure projects and their social visibility. More active civil society movements create difficulties in imposing user fees. For instance, using the Portuguese reality, strong opposition appeared when the tolls for the 25th April Crossing were raised to meet the contractual terms of the *Lusoponte* concession.[9] Given the social disturbance, the government was forced to rescind this decision. Another example, is the recent substitution of the shadow tolls for "real" tolls in the SCUT concessions, originating several protest actions.

[9]In the initial agreement, the tolls for both crossings - *Vasco da Gama* bridge and 25th April Bridge - were to be equalized.

In an attempt to identify areas of government expenditure more suitable for user charges, given the nature of the market and the "impurity of the goods", Duff (2004) presents the following conclusions (as an example, not an exhaustive list):

- For social services, public housing and general administration - benefit taxes and user fees would be inappropriate;
- For health care and education - charges might be imposed provided that access is guaranteed on the basis of right, need or merit;
- For transportation, water and sewerage, and the collection and disposal of solid waste - benefit taxes and user fees are specifically recommended.

Nevertheless, there isn't a particular formula to be followed concerning the decision whether to use taxes or users fees. Every infrastructure project should be evaluated by itself, taking into consideration, the macro-economic and social conditions of the populations that will be served with that infrastructure asset. In the end, it will be a political decision.

But what to expect concerning infrastructure investments and the main sources of financing given the recent economic recession and financial crisis? Next section highlights some possible trends.

3.6 Prospects for the future

In what concerns infrastructure projects the future seems to exhibit controversial trends. First, several developing countries, as well as, more developed countries will continue to struggle with fiscal pressures, not allowing to spend in infrastructure the needed amounts, not only into new projects but also, to rehabilitate the existing assets. Second, the availability of bank financing has not fully recovered from the credit crisis, with a syndication market nearly moribund and few active banks in the infrastructure market. At the same time, population growth and demographic changes will continue to require more quantity, quality and efficiency in public services provision. As an illustration, China and India alone will need more than US$1.5 trillion for infrastructure development in the period of 2010-2015, as reported in Fay et al. (2010).

International support for infrastructure projects (through MDB and similar agencies) will continue, but it is expected to suffer a decline and to be more selective. In recent years the international assistance has been substantial, supporting directly the stimulus packages to the economies, where infrastructure investments are significant. These anti-crisis packages reached for example, in 2009, in the World Bank Group, US$22 billion and another US$55 billion was leveraged from bilateral and multilateral agencies.

The private participation in infrastructure projects is expected to continue to growth, maintaining the trend of the last 20 years and it is expected to reach US$230 billion by 2013. From the attractiveness of the market will depend this pace of growth. In this respect, to provide better comfort to investors it is fundamental to continue to encourage better design of projects, professional project evaluation and appraisal, monitoring and control developed through all the life cycle of the project. Such processes contribute to reinforce the credit quality of projects and hence, to increase the likelihood of private market financing. As mentioned in Izaguirre (2010), in this crisis scenario, only projects with strong economic and financial fundamentals and the backing of financially solid sponsors, will be able to reach closure, in what reflects a general trend of "flight to quality". Commercial banks are adopting more conservative approaches with more stringent conditions. Typically, financing involves higher costs, shorter tenors and lower debt-to-equity ratios.[10]

Governments are facing hard challenges in the current economic climate in order to find solutions for the infrastructure gap. Public-Private Partnerships, at a first glance, appear as a promising mechanism to attract private capital, but nowadays this solution is far from consensual and several aspects merit careful attention. Next chapter will explore this topic with detail.

[10]The outlook for developing / emerging countries is further detailed in Section 6.2.

Chapter 4

Public-Private Partnerships

Public-Private Partnerships (PPP) have faced in recent years an exponential growth all over the world, not only in developing countries but also in developed ones, that find in PPP a new instrument to offer more infrastructure assets and better services to the public. PPP are used to build new and upgrade existing public facilities such as schools, hospitals, roads, waste and water treatment plants and prisons, just to mention some possibilities.

This chapter begins with a definition and overview of PPP and their historical perspective. Section 4.2 presents different possibilities for private sector involvement in the delivery of public services. Section 4.3 details the PPP delivery model, following a presentation of several related key concepts. Finally, Section 4.5 explains, briefly, the theoretical arguments supporting the use of PPP and clarifies in which circumstances PPP may offer a better solution than traditional procurement.

4.1 Definition and overview

There is no unique definition of PPP. For instance, one possible definition is presented by the European Commission (2004): "public-private partnership... refers to forms of cooperation between public authorities and the world of business which aim to ensure the funding, construction, renovation, management or maintenance of an infrastructure or the provision of a service". Inherent to the idea of partnership is that it should be mutual beneficial and seek to achieve compatible objectives. More definitions can be found in Allan (1999) or OECD (2008).

Although there are several definitions for PPP, as they come in different types and forms, the literature has reach a consensus concerning the main characteristics of this form of procurement (Allan, 1999; Grout, 1997; Välilä, 2005). The key characteristics are:

- The involvement of the private sector in providing public services or assets to meet public interest objectives;
- The long-term nature of the relationship;
- The distribution of risks between the public partner and the private partner aiming to achieve the optimality of risk allocation;
- The bundling of different project phases (e.g. design and construction or construction and operation);
- The private financing of the project (if not all, at least, a substantial part) and the use of project finance mechanisms.

Historically, forms of cooperation between the public sector and private sector could be found from the seventeenth to the middle of the nineteenth century, particularly in the form of BOOT (Build-Own-Operate-Transfer) or BOO (Build-Own-Operate) concessions. In a BOOT agreement the private partner design, build, finance and operate/manage the asset[1] and by the end of the contract, the asset is transferred to the public sector, free of charge. A BOO agreement is almost the same deal, but the ownership of the asset stays with the private partner. For instance, Lemos et al. (2000) and Sawant (2008) refer the construction of the Suez Canal in the nineteenth century, using private finance, as an example.

After a period of decline, on the late nineteenth and early twentieth centuries, explained by several economic and political reasons, like: financial failures where lenders lost significant amounts of money (e.g. the Panama Canal), abuses by the private sector in pricing the services provided, using their monopolistic power and an increasing government role in the economy, dictated by the emergence of socialist and communist policies; concessions have gain a new impetus starting in the 1970s (for further details on the history of concessions, see Lemos et al. (2000)).

A milestone in PPP development is the Private Finance Initiative (PFI) in the UK, which was introduced by the Conservative government in 1992. The PFI is different from traditional

[1] Also called a Design-Build-Finance-Operate (DBFO) agreement.

concessions because in the former, the government assumes strictly the role of buyer of the services provided by the private partner, instead of acquiring the assets. Later, in 1997, the incoming Labour government revitalised the PFI and rebranded it as PPP, an umbrella term that includes PFI. The general idea supporting PFI, and more broadly PPP, is to foster private involvement in the provision of public services, achieving a genuine transfer of risk to the private sector and at the same time, securing value for money in the use of public resources. See for instance, Allen (2001), Lemos et al. (2000) or Spackman (2002), for more details on the UK PFI.

More recently, the popularity of PPP and concessions can be explained by several reasons. First, severe budget constraints help to understand the need of private funds to implement projects otherwise not undertaken, or at least, not undertaken so soon. Second, is recognized that the private sector could offer innovation, expertise and efficiency delivering projects to the specified standard, on time and on budget. Third, a more general shift on the government's role in the economy, from direct provider of public goods or services to a procurer or regulator. Finally, Spackman (2002) argues that PPP were first used as "off-balance sheet" finance, helping governments performing the necessary infrastructure investments without compromising the public accounts. PPP allow the substitution of current investment costs, that the government will incur if procured the infrastructure asset in the traditional way, to a series of future payments. This substitution may make the government budget look "better", thereby undervaluing the cost of PPP and biasing decisions in favour of PPP, as emphasized by Allen (2001) or Monteiro (2005). This could be particularly attractive for the Euro countries, where there is a limit on public expenditure. The Maastricht Convergence Criteria and The Stability and Growth Pact require that government deficits should generally not exceed 3% of GDP.

It should be noted that the European Commission seems to encourage the use of PPP to develop infrastructure. Accordingly, they have published *Guidelines for Successful Public-Private Partnership* (European Commission, 2003) and the *Green Paper on Public-Private Partnerships and Community Law on Public Contracts and Concessions* (European Commission, 2004). These two documents offer guidelines, where in essence, the main concern is with the respect of the rules and principles of the Treaty: transparency, equality of treatment, proportionality and mutual recognition.

Although all the recent attention given to PPP, they are a small part of the public infrastructure market, as most public infrastructure projects are still traditionally procured. In a recent

study performed for the European market, from 1995 to 2006, Blanc-Brude et al. (2007) show that the importance of investment through PPP remains relatively small in comparison to traditional public procurement methods. The only European countries where PPP appear to have macroeconomic significance are the UK, Portugal and Spain. Even for the UK, where undoubtedly the PFI is very important and has played a pioneering role in the development of modern forms of PPP all around the world, the PFI remains of limited significance: "The vast majority of investment in the UK's public services has been, and will continue to be, procured through conventional means. However, other innovative procurement approaches, and PFI in particular, have been used to deliver some of the government's most complex and significant public sector infrastructure projects and programmes (...) The PFI programme continues to play a small but important part in the Government's investment plans" (HM Treasury, 2008). Studies performed by Deloitte (2006) and Grimsey and Lewis (2007), show that PFI projects represent between 10% and 13% of all UK investment in public infrastructure.

Evaluating the performance of PPP is a critical task and this evaluation should be made over the entire life cycle of the project. Most projects are either under construction or in the early stages of operation, thus there is only empirical evidence on the construction phase and researchers (Grimsey and Lewis, 2007; Grout, 2005; Nisar, 2007) have found that PPP perform better than traditional procurement in delivering the assets on time and on budget, particularly when PPP involve the construction of assets needed to deliver public services, like hospitals, prisons or roads. Also, the majority of the value for money tests reported significative financial savings when PPP are compared with conventional public procurement methods, yet this is not a consensual result, because some results point in the other way too.

However, a note of caution should be made: on one hand, it is a fact that using PPP, projects are delivered "on budget", but on the other hand, PPP are associated with higher costs. This suggests that a more realistic budget is used in PPP, because the private sector evaluates and prices explicitly all the risks supported and want to be rewarded for bearing them. It is showed by Blanc-Brude et al. (2006) in a study for the European road sector: the *ex ante* cost of a PPP road is on average, 24% more expensive than a traditionally procured road (all other things equal), and this difference is approximately similar to the *ex post* cost overrun reported in traditional procurement methods. This result seems to suggest that this cost difference is the consequence of the assumption by the private partner of the construction risks.

PPP do not offer a miraculous solution for every public sector infrastructure problem. There are also several drawbacks, mostly related with public sector inability to deal with such structures (lack of expertise and experience), insufficient competition and high transaction costs. For instance, in the UK, HM Treasury (2008) clarifies that PFI arrangements may be appropriate if the capital value of the project is above £20 million to ensure that procurement costs are not disproportionate. Sometimes, pooling a number of projects together will solve this problem, lowering procurement costs.

Not all forms of private sector involvement in the delivery of public services constitute PPP. Next section explains the different possibilities, highlighting the main advantages and drawbacks associated with each one.

4.2 Possibilities for private sector involvement

In the past, the government (including local authorities, municipalities and other public agencies) has often taken the exclusive responsibility of public service delivery, but there is a gradual recognition that this may not be the best solution to efficiently provide services to the public. Consequently, recent years witnessed an increasing trend to involve the private sector in infrastructure and in the delivery of public services. In the basis of this trend, several different arguments are presented in a mix of ideological, political, economical and financial factors, as cited in Lemos et al. (2000), not only to explain the flourishing of concessions, but also other forms of private sector involvement.

These arguments, already listed in the previous section, include the emergence of the New Capitalism that privileges the use of private capital and the regulatory role of the State instead of direct interventions, budgetary constraints faced by the governments, globalization of financial markets with the emergence of innovative financial instruments and new classes of investors, development of project finance techniques and lastly, but with no less importance, the private sector efficiency, as a result of competition, expertise and more capacity to design innovative solutions. This last reason was one of the main justifications given by governments to justify the partnerships with the private sector.

The difference between public service delivery models rest in the assessment, allocation and management of risk between the parties. Under traditional procurement, the public sector makes short-term contracts characterized by input-based specifications with different private firms (different stages of the project are contracted out separately) and ownership and funding are responsibilities of the government. But several other possibilities for private sector involvement appear in the delivery of public services. Following Pessoa (2006) and the World Bank classification, there are in general six typical forms:[2]

- **Short term service contracts** - Specific tasks, usually everyday maintenance jobs, are contracted to the private sector, but overall services management remains within the public sector;
- **Management contracts** - The government pays a private operator to manage the facility, the private firm respond to day-to-day routine maintenance needs by contracting private companies, on behalf of the public entity. This type of contract involves the payment of a fee to the private company and can provide gains in managerial efficiency;
- **Lease contract** - The government leases the assets to a private operator for a fee. The private operator maintains and operates the assets, taking on the operational risk, but is very demanding for the public entity, who remains with the responsibility for investments;
- **Greenfield Projects** - New projects usually built and operated by the private sector, which assumes the commercial risk. Such projects can take many forms, but the most common is Build-Operate-Transfer (BOT). Others forms of greenfield projects include Build-Own-Operate-Transfer (BOOT), Design-Build-Operate (DBO), Design-Build-Finance-Operate (DBFO) and Build-Lease-Transfer (BLT). High up-front investments required from the private sector and the long life of such projects, turn the distribution of risks between the parties a key cornerstone to achieve success.[3]
- **Concessions** - In a concession, the government grants a private entity the exclusive right to build, operate, maintain and carry out investment in an asset over the contract period. The private partner usually pays a fee to the government to obtain this right. Typically, concessions are free-standing projects, meaning that the investment costs will be recovered through the cash-flows generated by the project (for instance, toll roads where the private partner collect user fees - tolls). In this type of arrangement, ownership belongs to the

[2]Available at http://ppi.worldbank.org/resources/ppi methodology.aspx, accessed on May 6, 2011.

[3]Similarly, for brownfield projects, various acronyms exist, like, Rehabilitate, Operate, and Transfer (ROT), Rehabilitate, Lease or Rent, and Transfer (RLT), or Build, Rehabilitate, Operate, and Transfer (BROT).

public sector and by the end of the contract, the asset will revert to the public sector, free of charge. This form of involvement can generate high efficiency in operations and investment, but requires considerable commitment and regulatory capacity from the public sector.

- **Divestitures** - A private entity buys an equity stake of a public utility, through an asset sale, public offering, or mass privatization program. Divestitures may be classified into Full or Partial, if the government transfers 100% of the equity in the State-owned company to private entities or just a part, and in this last option, may or may not imply private management of the facility.

From the above description, it is obvious that options that yield higher involvement of the private sector, with more potential efficiency gains, also tend to demand a higher level of government commitment and a better prepared institutional framework. Table 4.1 presents the main advantages and drawbacks associated with the different possibilities.

Table 4.1: Pros and cons of the different private involvement options

Option	Typical duration	Pros	Cons
Service contract	6 months to 2 years	Can inject good technical expertise	Unlikely to greatly improve performance where overall management is weak
Management contract	3 to 5 years	Gains in managerial efficiency	Gains can be difficult to enforce; public entity remains responsible for investment
Lease	10 to 15 years	Commercial risk borne by the private sector, giving strong performance incentives	Administratively demanding; public entity remains responsible for investments
Greenfield projects	15 to 30 years	Good way of getting efficient delivery of bulk services, with private investment	Not a good solution if supporting distribution systems are in bad shape, or traffic levels are uncertain
Concession	25 to 30 years	Potential for high efficiency in operations and investment	Requires considerable commitment and regulatory capacity
Divestiture	Indefinite, but may be limited by a license	Potential for high efficiency gains	Requires credible regulatory framework

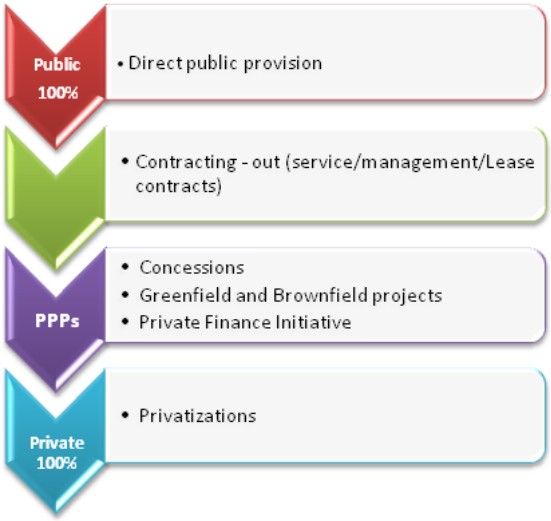
Source: Pessoa (2009)

Not all forms of private sector involvement are considered PPP. Albeit, as cited in the literature (HM Treasury, 2008; Välilä, 2005), there are no single definition for a PPP and it is possible to find similarities and overlaps between different delivery models. For clarification purposes, under the umbrella term of "partnership", sharing key features as the long-term nature of the arrangement, distribution of risks between the public and private partner and the resource to private funds, is possible to consider concessions, greenfield and brownfield projects, and other arrangements included in the private finance initiative (PFI), as PPP. This will be the approach followed in this work.

As already mentioned, in a PFI contract, the public sector buys services from the private partner. This kind of contract implies always a construction phase and an operational phase and the financing of the project is a responsibility of the private partner. Under the PFI arrangement, the private partner provides the capital asset and the services, the ownership of the asset belongs to the private partner and the public sector pays for the use of the facilities over the contract period, acting like a purchaser of services. According to Lemos et al. (2000), this is the main difference between PFI and a traditional concession. In a PFI deal, the public sector is no longer acquiring assets and providing for the services, but instead is only buying services. For that reason, PFI is not limited to economic infrastructure projects like concessions, but could be applied to several other sectors (social infrastructure) like schools, accommodation, prisons, hospitals, etc. As a conclusion, PFI may be considered as a sub-sector of PPP, with the specific purpose to deliver a service of publicly managed assets using private capital.

As a final note, it should be reinforced that PPP are different from conventional contracting-out arrangements and from privatizations. Typically, contracting-out involves a service provided by the private sector and that was previously provided by the public sector. But the responsibility and control remains with the public partner. In the case of privatizations, the ownership and the responsibility for the service provision is transferred to the private sector. According to Allan (1999), the common feature between these three possibilities is that, in each, the public sector role changes from direct provision to the public to its role as a procurer of services and a regulator. PPP lie somewhere between simple contracting-out and privatizations in the *continuum* of private *vs* public involvement. Figure 4.1 summarizes that idea.

Figure 4.1: *Continuum* of public *vs* private involvement



More recently, Grimsey and Lewis (2007) mentioned that hybrid approaches between conventional procurement and PPP are appearing. The purpose is to lower costs and at the same time, to obtain flexibility with a clear definition of responsibilities and rewards for the parties involved. To better understand PPP, next section presents the main features, advantages and drawbacks of this form of public service delivery.

4.3 The PPP delivery model

There are important key features characterizing PPP. *First*, the private sector is responsible for delivering an infrastructure asset and usually, also takes the responsibility for the operation and maintenance of this asset providing the related services. Under the most common form of PPP, the private sector designs, builds, finances and operates the asset based on "output" specifications decided by the public sector. The public sector defines the main goals to be achieved in terms of public interest (quantity, quality and price policy of the public services to be provided) and is the private sector, who is responsible for deciding how they will provide those services, desirably through innovative solutions. The private sector partner is usually a consortium that creates a special purpose vehicle (SPV). Through this separate legal entity, who is fully responsible for its own assets and liabilities, the project is carried out, without compromising the financial stability of the sponsors, avoiding risk contamination.

Second, risk should be allocated to the party best able to deal and manage it. As noted by Leahy (2005), a PPP does not necessarily mean that the private sector assumes all the risks, or even the major share of project's risks. The emphasis should be in the optimality of risk allocation, essential to ensure value for money, rather than the maximization of risk transfer from the public partner to the private partner. The risks are shared between the public and private sector and usually have a performance-based payment mechanism, in which the private partner will receive a stream of payments, from the government or from end users or both. The fact that payments are performance-related, ensure that the private sector has the right incentive to control and manage risk effectively throughout the contract period, in order to avoid penalties for under-performance or misconduct.

PPP projects face different risks and uncertainties, namely: sponsors, design and construction, operational and maintenance, political, legal, market, social and environmental and *force majeure*. Each project is unique with a particular location and a specific sector and therefore, is exposed to different risks with different degrees. In this context, the complex contractual structure typical of PPP, plays a fundamental role in the allocation of risks between the parties. It should be noted, that one of the major problems of traditional public procurement methods, rest in the correct assessment and evaluation of the risks and like cited in Leahy (2005), there are several examples of unsuccessful projects with delays and cost overruns, where an emblematic example is the London underground jubilee line extension project. The project has faced serious difficulties, largely due to problems on the construction phase associated with tunneling. From the initial forecasts of three years to completion, costing £2.1 billion, it was finished two years later, costing a total of £3.5 billion.

Third, PPP are usually long term arrangements, lasting from 20 to 30 years. In this respect, the establishment of a climate of confidence among the parties is critical for the success of the partnership, as typically, renegotiations will be necessary. In the words of Pessoa (2006): "The longer the nature of the objective, the larger are the uncertainties associated with the project and the more critical and relevant the third "P" of a PPP becomes".

Fourth, bundling of different project phases. Under traditional procurement methods, the public sector make different contracts with private entities for the construction of the infrastructure asset and for the maintenance/provision of a service. Under a PPP, there is only one private

entity who is responsible for the design, construction, operation and maintenance of the asset (bundling). The main justification is that way, the private partner has the incentives to take a whole life cycle approach. The private partner will make investments in the construction phase that will lower maintenance costs, improving the quality of the services provided.

And *fifth*, private finance is used, usually, a mix of equity and debt. Sometimes, also public funds may be used in a form of grants or subsidies. SPV's capital structure is highly leveraged and the debt-to-equity ratio could reach 90% in the case of PFI arrangements as mentioned in HM Treasury (2008). The benefits of private finance are well covered in several works (HM Treasury, 2008; Marty and Voisin, 2008; Nisar, 2007). The benefits may be summarized in the following: more effective due diligence and monitoring by private lenders, as they have long-term capital at risk, leading to improved whole-of-life risk allocation and management.

As mentioned in the previous chapter, debt is the main source of capital for infrastructure investments and lenders will receive interest and repayments according to a specific schedule. For projects that typically exhibit the characteristics of high leverage and long-term tenors, lenders will be particularly interested in the performance of the SPV in meeting the public sector criteria. The technical and financial viability of the SPV and its ability to deliver the service and repay the debt is critical. Marty and Voisin (2008) show that lenders are therefore, a third party in the deal that have the necessary expertise and proper incentives to conduct due diligence and close monitoring of the SPV activities, acting indirectly on behalf of the public sector and reducing problems of asymmetric information, as the public sector is the party less informed.[4]

Intrinsic to PPP there are several benefits that could be pointed. To the private sector, there are new investment opportunities through the accessibility to markets that once were an exclusive of the public sector, allowing greater diversification and profitability. In the public sector side, the advantages are probably more clear:

- Leveraging of public funds, allowing projects to proceed, even when the public funds are not available for their implementation. And as a consequence, allowing the governments to canalize their scarce resources to other high-priority areas of expenditure;

[4]This active role of lenders is further emphasized for projects financed by project finance mechanisms, with non-recourse debt.

- There is an explicit identification, quantification and allocation of risks among the partners, which is translated into more efficiency in risk management. By contrast, in traditional procurement, risks tend to be ignored as an element of cost;
- The involvement of the private sector allows access to economies of scale or scope;
- The use of a performance-based mechanism for payments, inducing quality improvements. Usually, payments only begin after the construction phase, when the provision of the service starts and are conditional upon the quality of the service provided. Using satisfaction metrics, PPP encourage a strong customer service orientation;
- Empirical evidence shows that PPP permit on-time and on-budget delivery and significative financial savings are reported. PPP can lower overall life cycle costs;
- More effectiveness and efficiency in public service delivery. Private partners are free from bureaucracy and not affected by political considerations, which allow them to operate more flexibly and effectively than a government department or agency;
- Private ownership stimulates a more profitable use of infrastructure assets through multiple uses;
- PPP may "serve as vehicles to introduce tolls or other user-charge systems, while still permitting government to distance itself from these developments" increasing public tolerance to such initiatives, according to Allan (1999);
- More efficiency in the procurement process. The need of preparing output based specifications makes the public sector focus on exactly what it wants. Hence changes causing cost increases, due to modifications on the public sector requirements, become less likely, as emphasized by Blanc-Brude et al. (2006).[5]

However, there are also several disadvantages in a PPP delivery model. In the words of Akintoye et al. (2003), the main problems are "high cost of the procurement process, lengthy and complex negotiations, difficulty in specifying the quality of service, pricing of facility management services, potential conflicts of interests among those involved in the procurement, and the public sector clients' inability to manage consultants". In summary, the worst drawback of PPP is high transaction costs, namely, costs with tendering, bidding, contract negotiation and

[5]Nevertheless, it was a problem for the first PPP that Portugal developed – changes required by the government had led to significant cost overruns as reported in Monteiro (2007).

monitoring. According to Allen (2001), these costs are three times higher in a PPP than in traditional public procurement.

Another consequence of high procurement costs is that it may compromise effective competition. Not all private firms have the necessary scale to enter in the PPP market and a lack of competition could be a problem in achieving value for money. Also, a lack of expertise by the public sector to deal with these arrangements is a common problem for several countries starting using PPP. But as the market evolved, these problems will be minimized through standardization of some procurement procedures and as more experience is gathered in the public partner side, lowering transaction costs. Although each project is unique, as mentioned in Lemos et al. (2001) there are strong similarities among projects in the risks involved and in risk mitigation techniques, allowing standardization. For instance, HM Treasury (2008) has developed a standardized version of PFI contracts, which is mandatory for all PFI arrangements.

But, several other concerns are addressed in the literature. *First*, private funding is more expensive than the government's cost of debt used in conventional procurement. This is a fact, but according to Grimsey and Lewis (2007) and Klein (1996), this is also a false argument. The apparent cheapness of sovereign funds reflects the fact that taxpayers are not remunerated for the risk they take. The public sector can transfer risks to taxpayers and end users without having to compensate them. However, if they were to be remunerated properly, then the difference between private financing and government funding would disappear. In addition, it should be noted that the assumption that governments are more reliable borrowers does not hold for all countries (see, at this purpose, the actual sovereign debt crisis affecting some European countries, including Portugal, and the impact on the government's financing costs).

Furthermore, de Bettignies and Ross (2009) show that private developers (using private funds) have also the advantage of freely terminate bad projects and only are capable of implement projects with positive and higher expected returns. On the other hand, public developers may choose to finance projects with lower expected returns and even, may sustain inviable projects for political reasons.

Second, if the PPP is to be refinanced, then costs and benefits should be balanced among the parties. Risks, liabilities and benefits should be shared among public and private participants, considering the life-cycle of the project. In most PPP, after a successfully construction phase,

there is usually a decline on risks compared to the risks at the project's beginning. Thus, it is possible to renegotiate the debt financing, obtaining more favorable terms. Also, the maturing of the market has brought more competition and more financial players, making possible to obtain better financial conditions. Although, there is an obvious argument that the public partner should share the benefits of renegotiations, this was not what happened in the early times of PPP.

Third, sometimes significant fixed payments are made by governments for a long time horizon and as a consequence, reducing government's fiscal flexibility. As mentioned by Hodge (2006) or Monteiro (2005), this "lock-in" effect of long term contracts might compromise the decision making capacity of future governments and is more generally related to the critical topic of "affordability", issue explored in the next section.

Fourth, there are also concerns related to community access to the services and the user fees "level". It is possible to solve these problems through contractual terms, where the public sector ensures the attainment of public interest objectives. In this respect, it is common to use shadow tolls for roads projects, as a support for low volume roads, based on availability or other performance measure. That way the government provides a subsidy to the private partner making the project viable. But, some problems still remain. For instance, in a study about the first wave of UK hospitals to be built under the PFI, Shaoul (2005) showed that using the value for money methodology the results "are far from rational and serve to redistribute wealth and increase social exclusion", in accessing health care services.

Finally, a *fifth* issue, related with the previous one, the PPP model is not applicable to all sectors. As illustrated by Riess (2005), the PPP model should only be applied to public services where the quality is relatively easy to contract on – services that can be clearly specified, measured and guaranteed – and where there is good potential for life cycle cost savings. Good candidates for PPP are services linked to roads, tunnels, bridges, water resources and supply, waste management and accommodation. By contrast, information and communication technology services (ICT) and core services in health, education and prisons, appear not to be suitable for PPP, although some success stories do not full corroborate these findings. See, at this purpose, the successful case of the "Joint Services Command and Staff College", an education project for the training of staff officers of all three Armed Services – Army, Navy and Royal Air Force, in the UK (Lemos et al., 2003).

Regarding ICT projects, they usually have a high degree of complexity and uncertainty, what makes a full specification of the output required to be delivered a very difficult task. For instance, Grout (2005) cites the Libra project, for the installation of a new computer system in the UK's magistrate's courts to replace a fragmented system, as an example of an unsuccessful ICT project. A lack of competition with only one bidder have resulted in poor project assessment and in a weak position of the government in the contract renegotiation.

Several key concepts appear related to PPP, namely the achievement of *value for money* in the use of public resources. The necessity to compute a *public sector comparator* to fully justify the option for PPP. Recently, also issues of *affordability* or *sustainability* are becoming central when discussing PPP. Next section explains these concepts.

4.4 Key concepts related with PPP

PPP should only be adopted if they are expected to deliver better value for money (VfM) over traditional procurement methods. Therefore, the assessment of VfM is critical in choosing the method of public sector delivery.

Value for money is a relative concept and is measured in terms of a comparison between different approaches to deliver public services. The ultimate goal is to inquire if public resources are spend economically, efficiently and effectively. It can be defined as "the optimum combination of whole-life cost and quality (or fitness for purpose) to meet the user's requirement" (HM Treasury, 2008). It is important to stress that this does not mean choosing among methods with the purpose of cost minimization. Cost is only one feature to be considered. Obviously, factors determining VfM will vary from project to project and between sectors, but it is an imperative that the VfM assessment should integrate any project appraisal.

As an example, the European Commission (2003) indicates several factors that normally contribute to the achievement of VfM in PPP: reduced life cycle costs, better allocation of risk, improved service quality, faster implementation and generation of additional revenue. In the

same line, the HM Treasury (2008) has published key drivers of VfM, from a public sector perspective, including: clarity on the objectives to be achieved, focus on whole life costs, optimization of risk allocation, rigorous identification, transferability and management of risks, long term nature of the contracts, use of output based specifications, competition, performance measurement and incentives, sufficient skills and expertise in both the public and private sectors, flexibility and an appropriate procurement process.

Grout (2005) illustrates potential VfM tests and their applicability. In essence, these tests try to answer the question if a PPP will bring more net economic benefits to the public when compared with the same project carried out through traditional procurement. This last option is normally called the public sector comparator (PSC). The PSC is, in essence, a benchmark against which the VfM of a PPP option is assessed. If the net present value of the option PPP is superior to the net present value of the PSC, then the VfM is demonstrated and the project should be carried following the PPP route.

As already mentioned, choosing a PPP is appealing for the governments, because the short term effect will be a reduction on government's expenditures and it will not contribute to the budget deficit. But PPP have also a long term effect and the future stream of payments to the private partner must be taken into consideration. Irrespective of the method chosen to public service delivery, affordability means that all the stream of government's expenditure should be "accommodated within the intertemporal budget constraint of the government" (OECD, 2008).

Similarly to the assessment of VfM, also, affordability must be based on a comparative assessment between two approaches: traditional procurement and PPP. VfM and affordability are related issues and it can be argued that if an approach has better VfM, it is also ensured that this approach is also affordable.

Affordability or financial sustainability should ensure fairness and equity among generations, and that public resources are distributed fairly between current and future taxpayers. A major concern in respect to PPP affordability is the risk of over-burden future generations of taxpayers. If governments do not commit themselves in efforts to conduct a long-term financial planning, matching the potential sources of revenues with the debt and other long-term obligations, then serious problems may arise. At this purpose, it should be noted that a typical argument used against the PPP model, is the lack of transparency and accountability.

Until now, the PPP model has been presented, highlighting the main advantages and drawbacks. This option is far from being a panacea to solve a country's infrastructure problems. Nevertheless some economic justifications appear supporting this form of procurement, issue explored in the following section.

4.5 The theory behind - Rationale for PPP

Economic theory highlights three main characteristics of PPP that help to explain the better performance when compared to traditional procurement methods: bundling, private ownership[6] and risk transfer (see de Bettignies and Ross, 2004; Dewatripont and Legros, 2005; Grimsey and Lewis, 2007; Grout, 1997; Riess, 2005; Sadka, 2006; Välilä, 2005). In the next sections, these topics are explored, but first, some key concepts are presented, addressing the role of the State in the economy and forms of public sector intervention.

4.5.1 Public sector intervention in the economy

In general, under a competitive free market the efficient amount of all goods and services is provided, but although this is a fundamental premise, it is only true for private goods. In reality, there are market failures, meaning a situation where the allocation of goods and services by a free market is not efficient. Typically, market failures include public goods, goods that generate externalities, asymmetric information problems and imperfect competition (e.g. monopolies).[7]

Public goods - Some goods and services have specific characteristics which imply that an efficient amount of them will not be provided by the free functioning of the market. Typically, pure public goods are non rival in consumption and non excludable. The first characteristic means that consumption of the good by one individual does not reduce availability of the good for consumption by others and the second one, that it is impossible to exclude any individuals from consuming the good (e.g. national defence and law enforcement). In this situation, no private firm would enter the market, there is no incentives to produce

[6] Not in the legal sense, as it will be explained in Section 4.5.3.

[7] This introductory section was based on Greater London Authority (2006).

this good and without public sector intervention, there would be no supply. On the other hand, there are pure private goods, which are rival and excludable in consumption (e.g. food) and here, the private sector has the necessary incentives to provide them. In reality, we have mixed situations that lie between pure public goods and pure private goods, *Mixed goods*.

Externalities - Where the actions of one agent creates a cost or benefit on third parties, which is not accounted for (spillover effects). In the case of positive externalities, not all the benefits are considered and the market will provide too less of this activity. By contrast, in the case of negative externalities, not all the costs are considered and the market will provide too much of this activity. There are also goods where the benefits to the society exceed the individual benefits. For instance, education which not only generates benefits to the individual but also to the society, more educated persons will lead to higher productivity. In this situation we have, *Merit goods*.

Information problems - A fundamental assumption under which markets are efficient is perfect information between all parties. But for some goods and services, information problems arise with complex information and when we have long time horizons involved, problems that may prevent the economic agents from making rational and efficient decisions.[8] Asymmetric information is also a common problem and it refers to a situation where one party have better information than the other. According to Dewatripont and Legros (2005), there are two types of information asymmetries: hidden information and hidden action, which in turn are closely related to the possibility of adverse selection and moral hazard, respectively. With hidden information, one agent has superior information compared to other agents and with hidden action, one agent can take actions that are not observable by the others. Thus, adverse selection can occur due to a lack of information, which can make economic agents enter a deal that do not deliver the level of satisfaction that was expected, prior to the settlement of the deal. Moral hazard can occur after the establishment of the contract. This phenomenon may appear because agents have an incentive to behave in a manner post-contractually that they were not expected to behave in, pre-contractually.

[8] In practice, it should be noted that unless information problems assume a huge proportion, the majority of markets are able to function without all individuals having perfect information.

Imperfect competition - Another fundamental assumption for efficient markets is perfect competition among all the economic agents. Perfect competition is characterized by the fact that no buyer or seller has market power (no single agent is able to influence market prices). But there are industries which are natural monopolies, typically the case of many infrastructure assets. In this situation, due to the high fixed costs of production, only one firm could be profitable in the long run. For instance, railways, water services, electricity.

All the cases above, examples of market failures, justify the intervention of the State to overcome these failures. These are included in the essential role of the State associated with the allocation of resources.[9] Public intervention aims to achieve allocative efficiency, also called Pareto efficiency, which occurs when resources are allocated optimally, meaning that it is impossible to make anyone better off without making someone else worse off.

Clearly and as illustrated above, there is a close link between market failures and the provision of infrastructure assets and public services. Hence, traditionally, public sector intervention has been mostly through public production and ownership. In this case, the public sector substitutes the market and provides essential goods and services, for instance, schools, hospitals, prisons, roads and rail networks. There are also other relevant forms of intervention, namely, through regulation correcting the functioning of the market and through taxes and subsidies, for instance, subsidizing activities with positive externalities and penalizing activities with negative externalities.

But either intervention took place to overcome market failures in allocating resources efficiently, or either for reasons of social justice, aiming to achieve a desirable distribution of income, governments may fail to be effective for different reasons. Electoral pressures, excess of bureaucracy, lack of capacity (incompetence, limited information or limited control over private responses to its actions) and improper motivation, are some of the reasons that may be pointed.

Moreover, the public sector has poor mechanisms available in deciding how to allocate resources. Where price information is not available the public sector tends to use cost-benefit analysis (CBA) to determine whether the benefits or value of an intervention outweigh the costs. The success of this analysis depends on the capacity to accurately assess both the costs and benefits.

[9] For completeness reasons, it should be noted that two additional roles are assigned to the State: redistribution of income and wealth – distribution function – and maintaining high employment, price stability and promotion of economic growth – stabilization function of the economic activity (Musgrave and Musgrave, 1973).

To conclude, it is important to note that public sector intervention must arise from the presence of a market failure and has a cost, introduces distortions to the economy and could be not effective. Public sector funds come from taxation on individuals and businesses and it is important to evaluate the full benefits and costs of the intervention. A PPP appears as a new mechanism of market intervention, which substitutes traditional public management and ownership. In this respect, Välilä (2005) emphasized that a PPP should be used to alleviate market failures inherent to the provision of infrastructure assets or public services, but must prove to be an advantageous solution over traditional public provision.

4.5.2 Bundling

As already mentioned, one of the typical features of a PPP is bundling of different project phases. The public partner usually makes a unique contract with a private consortium involving the construction and the operation / maintenance of the assets in order to deliver the services. The main advantage of bundling is that complementarities between tasks, namely, design, construction, finance and operation, will give the private partner incentives to minimize costs in a full lifetime basis.

Theoretical literature focusing on bundling as a key feature of PPP is based on incomplete contracting models (Hart, 2003) or asymmetric information models (Bentz et al., 2002).

Hart (2003) uses a incomplete contract framework to explain in which circumstances PPP are a better choice when compared with traditional procurement. Specifically, the trade-off between generating life-cycle costs savings and meeting public-interest objectives, is explored. In Hart's model, two types of investments can be made at the building stage by the private partner, that will affect the operation of the asset:

- *Investment A* - that will lower the cost of operating and maintaining the infrastructure and at the same time, will improve the quality of the service to be provided. An example is an innovative design of a prison building, allowing a reduction of the number of security guards needed. This investment will reduce maintenance costs and improve the quality of the facility (better security conditions).

- *Investment B* - that will reduce costs in the operating phase, but contrary to investment A, it will also reduce the quality of the service. With the prison building example, consider the use of new materials in the construction phase that allow better durability which induce lower maintenance costs, but at the same time, may create problems of lighting and air quality, lowering the quality of the building.

In this model, contract incompleteness imply that, first, both investments are non-contractible, meaning that at the settlement of the initial building contract, they are not predictable. And second, that impacts on service quality induced by these cost-saving investments, although noticeable, are still within the scope of the contract.

Under traditional public procurement, the public sector contracts separately with different private entities for the construction and for the operation / maintenance of the asset (unbundling). In this case, clearly, the builder has no incentives to perform the investments, as any profit will revert to others. With bundling (under a PPP), both investments will be carried out because the benefits, in terms of lower operating costs will be internalized by the builder/operator. In this last situation, from a society perspective, a PPP could be an optimal choice if the welfare gains associated with investment A are large enough to offset a possible welfare loss associated with investment B. It is possible to conclude from here, that if it is easy to contract on the service quality and therefore overcome the loss of welfare induced by investment B, the stronger are the reasons supporting the choice of a PPP.

In another strand of the literature, Bentz et al. (2002) assume that contracts are complete and use an asymmetric information model that stress the role of private information about operating costs. The main insight of the model is that bundling appear to be a better solution in solving agency problems when service delivery and cost reducing investments are relatively cheap. The basic assumption of the model is that the operator privately knows whether operating costs will be low or high and in this latter situation, he can exert effort during the construction phase in order to cut these operating costs. As a natural consequence, the operator will have an information rent.

Under a PPP delivery model, the amount of information rent going to the private partner is greater the more efficient the asset is. Therefore, the private partner (builder/operator) will have the incentive to make the right build choice ensuring efficiency at the operational stage,

without additional costs to the public partner. By contrast, in the traditional procurement model, compensation should be given to the builder, who has to be incentivized to ensure that the asset is as efficient as possible. In this situation, in a public's sector perspective, a PPP is relatively cheap compared with traditional procurement.

However, in a PPP, the more costly investments are, more information rent the public partner should leave to the private partner in order to implement the necessary investments. The public sector will provide incentives only up to the point, where increasing the information rent any further, will became to costly. In this situation, a PPP may become too expensive and traditional procurement is then preferred.

4.5.3 Ownership rights

Another key characteristic of PPP is private ownership, but first a clarification on the concept of ownership is needed. Ownership should be not interpreted in the legal sense, but meaning "residual control rights" over an asset. In PPP, the private partner is also the owner, which has the right to decide all usages of the asset during the life of the contract, even when in the legal sense, ownership belongs to the public partner (the typical case of concessions).

In addition, investments in infrastructure assets are typically relationship-specific investments. Assets are build specifically to produce some service and they cannot be readily used for other purposes. In this situation, all the parties engaged in the deal have more advantages if the project is brought to completion than if it fails. The specificity inherent to infrastructure assets, reinforces the role of relational contracting, i.e., all the parties involved in the project have a stake in preserving the continuity of the relationship.

The most commonly used theoretical approach to the issue of ownership rights is contract incompleteness (see Bennett and Iossa, 2005; Besley and Ghatak, 2001; Hart et al., 1997). Contracts are naturally incomplete, because it is impossible foresee every contingency and if it was possible, it would be probably very difficult to include all in a contract enforceable by law. This aspect is emphasized in PPP, given their long-term nature, high complexity and uncertainty originated by the exposition to a variety of risks and by the involvement of a large number of stakeholders. Moreover, because PPP are often set up to deliver services, which are hard to measure and monitor.

In the presence of relationship-specific investments and contract incompleteness, opportunistic behaviour by the parties may arise, making use of their bargaining power (Williamson, 1981). In this context, ownership is a critical feature - the part who is the owner of the asset has a superior bargaining position in renegotiation and it will affect investment incentives, as emphasized by de Bettignies and Ross (2004). Under traditional procurement, the public partner is the owner and therefore any cost-saving investment performed by the private partner will revert to the public partner. Thus, the private partner has no incentives to seek cost savings. By contrast, with private ownership (under a PPP) the benefits from cost-saving investments will revert to the private side, providing the necessary incentives to undertake the investments. Nevertheless, the incentives to cost reduction may become too strong, and may compromise quality.

To illustrate this, Hart et al. (1997) provide an example with prison services. If the contract concerning service quality is incomplete, then the private partner may deliver a service that fall below a socially acceptable level if the incentives to cut costs cannot be controlled. By contrast, under public ownership, any investment in cost-cutting that may compromise service quality will not be done, ensuring the desired level of quality. As mentioned in Välilä (2005), Hart's model also stresses that even if effort to cut costs did not reduce service quality, it could have an indirect negative impact – "the profitability of cost-cutting may induce the private partner to focus too much on it and too little on quality improvement".

Bennett and Iossa (2005) assume a symmetric information model with contract incompleteness. In their model, the role of the end-of-contract (residual) value of the asset is explicitly considered and the impact of renegotiations is emphasized. Bennett and Iossa (2005) consider two types of investments that can be made at the construction phase: both investments improve quality but one, increases cost at the operational stage (negative externality) and the other reduces the operational cost (positive externality). Both investments increase the residual value of the asset.

As pointed by Riess (2005), the investment which they call to have a negative externality, could be desirable from a society's viewpoint if the benefits of a higher quality public service (for instance, a safer road) and the increase of the residual value of the asset exceed the sum of higher construction and operating costs. In this situation, bundling and private ownership is not optimal and traditional procurement may be better, since the private partner has no incentives to make the investments due to its adverse impact on operating costs.

With the other investment (positive externality), there is no doubt that bundling offers the best solution. With private ownership and control rights, investments will be made at the building stage and the benefits will be internalized by the private entity. Nevertheless, things are not so clear if control rights are left with the public entity. In this case, to make a cost-saving investment in the building phase, the private partner will need the agreement of the public partner and renegotiation will occur where, typically, any benefit will be shared with the public partner. Therefore, control rights should lie with the private partner if the cost and residual value are more important than the social benefit effect, otherwise, should rest with the public partner.

In a PPP, by the end of the contract two possibilities exist concerning ownership of the asset – it will rest with the private sector or it will be transferred to the public sector, sometimes automatically and free of charge (the usual approach). At this purpose, Bennett and Iossa (2005) show that an automatic transfer clause will prevent investment incentives, given the unverifiability of investments and residual value (moral hazard), turning it a poor solution. By contrast, if the private partner expects to transfer the asset to the public partner, receiving a compensation, this will improve incentives to perform investments.

Besley and Ghatak (2001) particularly address the issue of public goods. In the general framework of Grossman and Hart (1986) and Hart and Moore (1990), in the presence of relationship-specific investments - valuable, only in a specific relationship - if the deal fails, the party who is the owner gets some benefit while the other party gets nothing. But for public goods the situation is different and both parties could have some benefit due to positive externalities. The example cited in Besley and Ghatak (2001) illustrates the case where a private entity – a non-governmental organization (NGO) – with an educational mandate may get benefits from improvements in the quality of a school, even if it is not directly involved with its operations, given the "public" nature of the good. The final result stresses that ownership should rest with the party that values the benefits generated by the project relatively more, regardless of the importance of investments or other aspects of the technology. At this purpose, de Bettignies and Ross (2004) emphasize that if the public partner values the public good more than the private partner, then the ownership should rest with the public partner irrespective of his level of efficiency.[10]

[10] A result against the PPP superiority based on private ownership.

4.5.4 Risk transfer

The third key feature separating traditional procurement from PPP is the sharing of project risks. According to Blanc-Brude et al. (2006), the theoretical PPP literature has been concentrated on ownership and bundling and so far, has disregarded the issue of risk transfer, although this issue is closely linked to the first two.

PPP have long contract periods and usually, difficulties may arise with measuring and monitoring some infrastructure assets and the related services to be supplied. These features make PPP particularly susceptible to uncertainty and risks.

As pointed by Grout (1997, 2005), the main advantage of risk transfer is that this process leads to a more explicit recognition, quantification and pricing of the risk. Risk does not disappear but is allocated optimally, to the party best able to deal with it.[11] Each partner, for the risk assumed, will attempt to minimize any negative impact the risk could have on the project, leading to an improved risk management.

As already mentioned, the contractual structure of a PPP is a feature of major importance in the risk allocation process. The use of contracts leads the different parties to internalize the various costs of a PPP project, using a whole-life-cycle approach. Any failure in contract design may compromise the efficiency gains that could potentially be achieved through PPP.

Also in the same line, it has been emphasized that a genuine risk transfer must occur from the public sector to the private sector, in order to a PPP generate VfM. Although this is a consensual rule, practical difficulties may arise due to the complexities of the arrangements. For instance, proper risk transfer is particularly challenging when the infrastructure project involve partnerships with two different private partners, as the case of the first wave of PPP made by the Portuguese government in the health sector. In these projects, risks, responsibilities and benefits had to be shared between two concessionaires, one in charge of the hospital building and respective maintenance and the other, delivering clinical services.

[11] By contrast, under traditional procurement methods, the quantification and pricing of risks tend to be ignored.

There are many classification schemes to the numerous risks that can be present in infrastructure projects.[12] It is essential that the public sector retains some of the risks to make a PPP financially and economically attractive to private entities, including lenders. Usually, macroeconomic and political/legal risks are assumed by the public sector and project-specific risks are carried by the private sector (e.g. construction and operation risks). Of particular concern is *demand or commercial* risk. Arguments can be made for the public sector to carry this risk, because through its actions, general economic policies or sector-specific policy measures, it is possible to influence demand. But on the other hand, the private partner should assume at least, part of this risk, to ensure the right incentives to promote efficiency at the project level. In practice, what happens is that usually this risk is shared accordingly to a specific formula. As an illustration, typically for transport projects, a band is defined and within the band the private entity assumes the risk and has an incentive to seek efficiency, resulting in more profit. Outside the limits of the band the public sector carries the demand risk, sharing or supporting losses, and additional gains.

As a final note, concerning risk management, in general the public sector is in a weaker position than the private partner whenever renegotiations of the initial contracts are necessary. There is an asymmetry in the public-private relationship due to the particular characteristics of the public service - once a project starts in the operational phase, the public sector will try to avoid any disruption of the service and the private partner may act opportunistically to explore this advantage. The experience with PPP contracts highlights the need to manage the risk in a strategic way, using a whole-life cycle approach and with insights from the principal-agency theory and game theory.

4.5.5 A summary - When to use PPP?

Accordingly to the economic theory and the exposition in previous sections, PPP offer a better solution than traditional procurement when there are synergies between the construction and operation phases, there is potential for cost saving investments, it is relatively easy to contract on the service quality, and finally, when efforts to improve productive efficiency through cost saving investments do not compromise, seriously, service quality and the attainment of public interest objectives. As a result, economic infrastructure projects are good candidates for PPP.

[12] Recall Section 2.4.

However, the practice sometimes is different from the theory and it is possible to find PPP in sectors where it will be difficult to fulfill all the criteria indicated, like in the case of ICT projects or core services in health, education or prisons. Although contracts can address some quality issues, problems may arise when the government cannot fully specify the quality of the output and in this situation, private partners may be tempted to cut quality in the process of cutting costs. For instance, in education, the private partner may choose to replace expensive teachers with cheaper ones; in health care services, concerns are related to the quality of care and to the possible rejection of patients that are expensive to treat; and in prisons, hiring unqualified guards to save money may lead to problems of safety and security of prisoners (see Hart et al., 1997; Riess, 2005).

In addition, transaction cost theory[13] suggests that contracting costs are likely to be higher for projects with high asset specificity, high complexity and uncertainty, low competitiveness and low government contract management skills, notably, the case of infrastructure projects. Long-term complete contracts are impossible to write because unforeseen contingencies may appear during the life of the contractual relationship, and in the presence of relationship-specific investments, problems of adverse selection and moral hazard may arise, as a consequence of a potential opportunistic behaviour of the parties, increasing transaction costs (Parker and Hartley, 2003; Williamson, 1981).

The first solution to these problems is "vertical integration", a situation where the governments choose traditional public provision. In a context of PPP, a possible but inefficient solution is try to complete the contract – adding incentive and penalty clauses, performance standards and arbitration options. Another solution is to guarantee effective competition, ideally, *ex ante* and *ex post* competition. While *ex ante* competition is a much easier condition to satisfy – it is only necessary to have a large number of qualified bidders at the outset, sharing the same conditions, problems arise with *ex post* competition. After winning a bid, the relationship is developed bilaterally. Relational contracting appears as a different approach to deal with these contractual difficulties. As cited by Bertelli and Smith (2010), transaction costs in long term contracts can be lowered by nurturing relationships based on trust and cooperation. Trust and credibility must be developed between the different network actors, having the effect of reducing the (expected) opportunism and transaction costs.

[13]Transaction costs "arise from the costs of seeking out buyers and sellers and arranging, policing and enforcing agreements or contracts in a world of imperfect information" (Parker and Hartley, 2003).

As a final note, some key points must be stressed:

- First, PPP allow the expansion of infrastructure assets and services, beyond the government possibilities that usually face budgetary constraints and have a lack of project management skills;
- Second, concerns appeared with PPP long-term costs and benefits. Because governments can borrow more cheaply than the private sector, the extra-financing costs with the resource to private investors inherent to PPP arrangements, need to be compensated by savings in other aspects of the project, to justify the option for a PPP scheme. The VfM must always be demonstrated;
- Third, the PPP choice must be made on the grounds of efficiency and not, as a fiscal option. According to Välilä (2005), there is a real risk of the PPP option being driven by political and accounting considerations rather than by economic efficiency considerations.

Summing up, it is possible to conclude that if several conditions are met, a PPP can be more efficient than traditional public procurement, but the cost of higher efficiency translates into higher transaction costs, undermining competition. Nevertheless, PPP allow the construction of important infrastructure assets, otherwise probably not possible due to budget constraints. Some potential key factors for success include, the public sector ability to develop a proper institutional framework and the skills / expertise to manage the PPP arrangement over all the life-cycle. Enough competition should be ensured and an optimal risk allocation should be pursued.

Portugal is one of the European countries that privileges PPP as a tool for infrastructure development. PPP are used in large projects to develop essential infrastructure assets in transportation and health, particularly greenfield projects. But although the long history of Portuguese PPP, few papers have addressed this topic. Next chapter aims to present the Portuguese experience with PPP, detailing five distinct PPP projects and programmes.

Chapter 5

The PPP Portuguese Experience

The first major infrastructure project developed in Portugal under a Public Private Partnership (PPP) scheme and financed with a Project Finance mechanism was the construction of the *Vasco da Gama* bridge that started in 1994. The Portuguese history with PPP had started approximately two decades ago and yet, there is a scarcity of papers on the topic. Besides the reports from *Tribunal de Contas*, the Portuguese Supreme Audit Court, and from the Finance Ministry, there are few papers focusing the Portuguese experience with PPP, what can be explained due to information unavailability and data limitations. Notably exceptions are the papers of Lemos et al. (2004), Marques and Silva (2008), Monteiro (2005, 2007) and Sarmento (2010). This issue is particularly relevant for Portugal, since PPP appear to be of macroeconomic significance only in the UK, Portugal and Spain, if we consider the European countries as noticed by Blanc-Brude et al. (2007), and because Portugal is the European country with more PPP as a percentage of GDP.

This chapter aims to make a balance and critical analysis of the Portuguese experience with PPP. To accomplish that we focus on particular PPP projects, particularly transport projects. In addition we develop a method to ascertain the relative efficiency of the SCUT concessions (shadow toll highways), based on Data Envelopment Analysis (DEA). This chapter is organized as follows: Section 5.1 presents the legal and institutional framework, Section 5.2 describes the major projects developed under PPP schemes, starting with a general overview and then detailing five distinct projects and programmes, Section 5.3 explains DEA as a tool for measuring efficiency and performance and we proceed with an application to the SCUT projects. Finally, some general conclusions are drawn in Section 5.4.

5.1 Legal and institutional framework

In Portugal, like in other European countries, the legal framework only appeared several years after the first PPP project, more precisely in 2003. It was the practice and experience with PPP that dictated the need for a proper and general regulatory framework. Before that, PPP initiatives were governed by the general legal provisions that were applied to contracts submitted to the public legal regime (such as public service concessions) and were launched and regulated through specific legislation, tailored for each project.

The most important Portuguese legal diploma is the Decree Law 86/2003 from 26th April, also called the PPP Law which had suffered improvements with the Decree Law 141/2006 from 27th July. These two legal diplomas provide a unified framework to PPP assessment and complement already existing and avulse sector legislation, for instance, in transportation and in the health sector.

The Decree Law 86/2003 designed a framework for PPP appraisal, establishing several institutional rules for risk assessment, including the computation of a Public Sector Comparator (PSC) for each project. It starts with a definition of a PPP (adapted from art. 2): A PPP is a long term contractual agreement, in which private entities take the responsibility for the development of activities to fulfill a collective need. Financing, investment and management are private sector responsibilities (total or partial). Short-term projects with a time span of 3 years or less, and with investments under 25 million Euros, are excluded.

To complement the definition above, art. 4 and 5, add that: The main goal to achieve with a PPP is an increase of efficiency in the use of public resources with improvements in quantity and quality on the service to be provided. Also concerning project responsibilities, the public sector should act like a controller ensuring the attainment of public interest objectives and the private sector should take the tasks of project's financing (total or partially) and management.

More recently, the Decree-Law 141/2006 reviewed the PPP assessment framework, introducing relevant improvements, particularly to protect the public sector interests. This new legislation reinforces the articulation between the line ministers involved (finance minister and other sectoral minister depending on the PPP) and introduces mechanisms to improve the financial control of the partnership. Some relevant changes were the following: competition in the bid-

ding stage is now required – projects with only one bidder are interrupted; all the necessary environmental licences and local authorities permits should be obtained before the launching of a PPP deal by the government; more transparency is needed in the use of external consultants; the sharing of refinancing gains and possible indemnities to the private partner in case of unilateral changes of contracts by the government should be contractually predicted.[1] In addition, the modalities for restoration of the financial equilibrium are now specified (see art. 14-C), which constitutes an important clarification when renegotiation of the deal occurs. Moreover when the Portuguese experience shows a high incidence of renegotiations with an increased cost for the government.

Besides the main legal framework provided by the two diplomas mentioned above, public entities should also comply with the Budgetary Law (Law 91/2001) in what concerns financial expenditure, and with the Code of Public Contracts (Decree-Law 18/2008) in respect to the procurement phase of the project.

It is worth to mention that the majority of the PPP projects adopt the structure of a Design-Build-Finance-Operate (DBFO) agreement and use the legal instrument of a concession contract, although other possibilities exist, as mentioned in art. 2 from the Decree Law 86/2003. As a consequence and because there isn't an universal rule for reporting and accounting the PPP expenditures, Portugal follows the recommendations of EUROSTAT[2] concerning the qualification of the assets. Regarding concession models, the asset is considered private as long as less than 50% of the project's revenues come from payments by the public sector. Differently from the classification of expenditure in Private Finance Initiative (PFI) models, where the asset is considered off-the-balance-sheet as long as the risk of construction and at least, the risk of service availability or the risk of demand are transferred to the private entity (Mahony and Gunnigan, 2009).

Concerning the legal aspects, it should be recalled that the European Commission does not have a specific legal framework to rule PPP, only offers guidelines. For instance, *The Green paper on PPP* (European Commission, 2004) and *Guidelines for Successful PPP* (European Commission, 2003), already mentioned in Section 4.1. Recently, a European PPP Expertise Center was created in 2008, in a joint initiative of the European Investment Bank (EIB), the

[1] It would be possible to identify changes that are reasonably expected in the short to medium term, including foreseeable legislative modifications and to include that in contracts.

[2] EUROSTAT is the statistical office of the European Union.

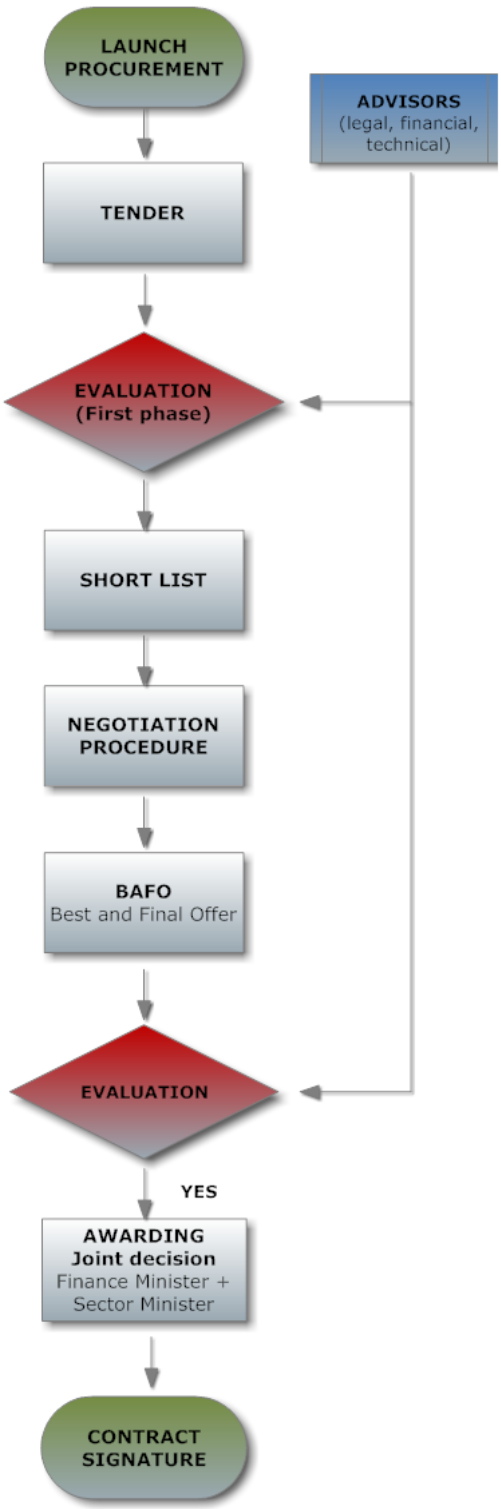
European Commission, 30 European Union Members and associated countries. The main goal is strengthen the ability of the public sector to engage in PPP. To accomplish that, the Center stimulates the effective sharing of experience and best practices among members, provides support for project preparation and advisory services to the public sector promoters.

Prior to the decision to adopt a PPP model for the development of any infrastructure project, several steps are followed according to the Portuguese legal framework. First, a report should be prepared by the public entity proposing the project under a PPP scheme covering the following items, as mentioned in Mahony and Gunnigan (2009):

- macro and micro-economic evaluation of the costs, benefits and of the public interest of the project,
- the political framework of the project regarding the government political program,
- the business model proposed including financing sources and legal arrangements,
- quantification of the PSC to justify the choice of a PPP,
- compliance with the Budget Law regarding multiannual expenditures,
- establishment of a balanced contractual relationship, concerning risk allocation and the sharing of risks and rewards, within a rigorous definition of contract scope,
- transparency in the public tendering procedure, by establishing careful evaluation criteria and discipline in the negotiations stage,
- consideration of possible implications if the decision is not to proceed with the PPP route,
- careful definition of all scenarios of possible non-compliance by the private partner, through the adoption of guarantees, penalties and the right to the termination of the contract.

Concerning the procurement process for PPP, in general two different phases are required: a pre-procurement phase including planning, design and preparation of tender; and the procurement phase in itself, involving bidding and negotiation. The procurement phase can be illustrated as Figure 5.1 highlights.

Figure 5.1: Procurement Phase for PPP in Portugal



Source: Adapted from Mahony and Gunnigan (2009) and Tribunal de Contas (2008b)

Some notes on the Figure 5.1. Given the high values of PPP contracts, the tender procedures are usually open to public and international competitors, with the tender announcement published in the Official Journal of the European Community (OJEC). In the first stage of the process, the bidders are evaluated based on several criteria, for instance, suitability of competitors and the technical, financial and legal features of the proposal. The best qualified bidders are chosen to a second stage of negotiations (Short List), which ends with the presentation of the best and final offer (BAFO). From here, and according to the contracting law, the tender evaluation committee should choose the most economically advantageous proposal, based on economic indicators like the Net Present Value, but also performance indicators, the quality of the services, environmental aspects, technical merits of the solutions, among others.

Attention is now turned to the institutions that in Portugal are involved in PPP. Besides the obvious role played by the private and public partner, several other institutions participate on the PPP market, namely:

- *Direcção-Geral do Tesouro e Finanças* (DGTF) – It is an internal control body, which aims to control the financial administration of the State and to contribute to the economy, efficiency and effectiveness in public expenses and revenues. In 2007, a particular structure was created within the DGTF – the *Gabinete de Acompanhamento do Sector Empresarial do Estado, das Parcerias Público-Privadas e das Concessões* (GASEPC), that has the responsibility of monitoring PPP projects using a long term financial planning program, and of ensuring financial discipline and fiscal sustainability of the partnership throughout the life cycle of the project. In broader terms, ensuring the affordability of the PPP project.

- *Lenders* – Funds for projects' development may come from several sources, but usually involve commercial banks and supranational institutions, which often require the intermediation of commercial banks to assume risks, as detailed in Chapter 3. For projects developed in Portugal, it should be emphasized the role developed by the European Investment Bank (EIB). This Bank assumes particular relevance, given its nature of a multilateral development bank that provides loans primarily to countries of the European Union. The EIB provides long term loans to governments in order to develop projects with substantial investment needs, contributes with its experience in setting up operations and acts as facilitator to private investment. Using 2003 data, the majority of PPP projects financed by the EIB were transport projects (around 80%), with the remainder

in health, education, water and sewerage sectors. Concerning country exposure, Portugal accounted for 19% of the EIB's PPP project portfolio, just after the UK with 24%. With more recent data, in terms of lending volume, all PPP projects accounted for 32% of the total EIB transport lending in 2010, showing EIB support to PPP programmes, in spite of the difficult financial environment.

- *Parpública* – A State firm which acts as a PPP knowledge center and advisor to the Portuguese Finance Minister. *Parpública* is responsible for monitoring the development of PPP projects through the collection, analysis and diffusion of information. Also, this PPP Unit has the tasks of providing expertise to sectoral ministries, perform the evaluation and appraisal of projects, preparation of tender documentation, evaluation of bids and is involved in the supervision of contracts that are being renegotiated with private partners.

- *Tribunal de Contas* – The Portuguese Supreme Court of Auditors is a financial court that examines the legality of public expenditure and audits the accounts of the State, focusing on the economy, efficiency and effectiveness with which the public money was used. It is a sovereign body, independent, that is not included in the State Administration. The Court has been developing reports on the impact of PPP in public accounts and thus, making an important contribution with its recommendations to improve all the PPP framework.

In addition, the supervision of the PPP contracts is a responsibility of different entities depending on the sector of activity. Thus, InIR – *Instituto das infra-estruturas rodoviárias* and IMTT – *Instituto da mobilidade e dos transportes terrestres* have the responsibility for the supervision of the private concessionaires, respectively, for road and railway sectors. The InIR's mission is to "supervise and oversee the management and operation of the road network, monitoring compliance with laws and regulations and concession agreements, to ensure the completion of the National Road Plan and the efficiency, equity, quality and safety of infrastructure, upholding the users' rights". Concerning IMTT, through its unit called URF – *Unidade de regulação ferroviária*, develops the main tasks of economic and technical regulation of the activities in the railway industry with a special focus on the relationship between the infrastructure management and the transport operators.[3]

[3]Available at http://www.inir.pt/portal/ and http://www.urf.imtt.pt/, accessed on June 1, 2011

In what concerns the health sector, monitoring and supervision of the PPP has been committed to *Parcerias.Saúde*.

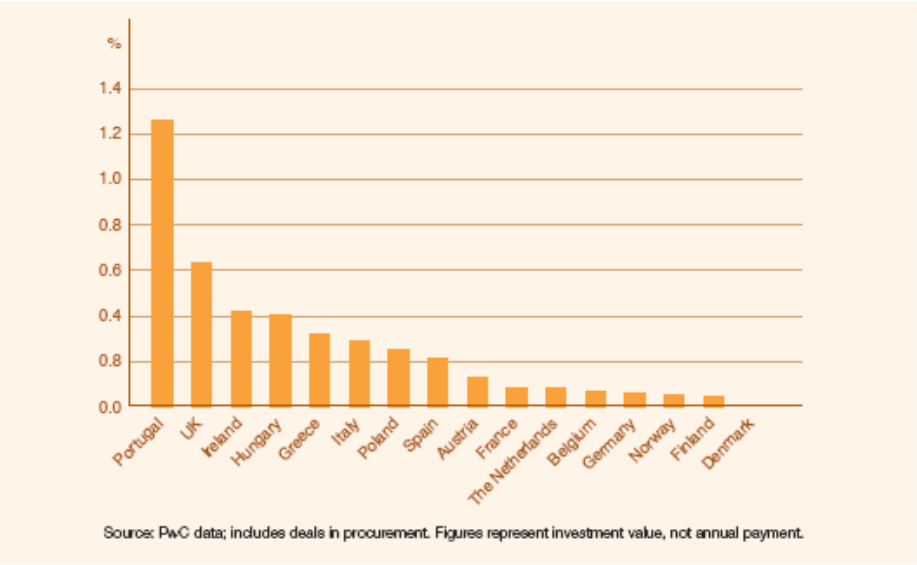
Recently, in 2009, the Lisbon Catholic School of Business & Economics has created the Observatory of PPP (OPPP). The main purpose of this observatory is to develop systematic and rigorous studies on the Portuguese PPP that are only available to the adherent members. The OPPP includes all categories of stakeholders in the PPP market, namely, banks, consultants, regulators, construction firms, equipment suppliers, government departments and law firms.

Next section presents several of the major Portuguese PPP projects, starting with a general overview and detailing five distinct projects and programmes.

5.2 Portuguese relevant PPP projects

Portugal is currently the European country with the highest percentage of PPP, either in relation to GDP or in relation to the State Budget (Tribunal de Contas, 2008b). Figure 5.2 highlights this same fact.

Figure 5.2: Average 2000-2005 PPP activity as a percentage of GDP



Source: Pricewaterhouse Coopers (2005)

PPP projects in Portugal are mostly concentrated in the transport sector (highways and railways) but more recently, PPP are being developed in other sectors like health. According to the last report from DGTF (2010), the Portuguese PPP universe in the end of 2009, accounts 120 projects from which 96 are in the operating phase, 18 are in the investment / construction phase and 6 are in the procurement phase.[4] Concerning sectors, the bulk of PPP contracts are in the transport sector. Similarly to previous years, PPP investments in the road sector lead, accounting for 41% of the total investment through PPP in 2009. Besides the projects identified below, several projects related to water supply and sewerage systems were awarded to private entities by municipal authorities using the PPP model. Table 5.1 lists the major PPP projects developed in Portugal, based on information from DGTF (2010) report.

Table 5.1: Major PPP projects in Portugal

PPP project	**Project phase**	**Investment** EUR millions
Lusoponte (Vasco da Gama Bridge)	completed / under operation	867
Real toll highways (5 concessions*)	completed / under operation	4687
Shadow toll highways (7 concessions)	completed / under operation	3211
Real toll highways (8 concessions**)	under construction	3564
Real toll highway (*Pinhal Interior*)	tender phase	958
Fertagus Suburban rail service	completed / under operation	900
Metro Sul do Tejo tram system	under operation	269
High speed railways (PPP1 and PPP2)	tender phase	3296
First wave hospitals (*Braga, Cascais, Loures*)	under construction	263
Hospitals (*V.F.Xira,Lisboa Oriental, Algarve*)	tender phase	1622
Emergency and Security - SIRESP	under investment	112

Legend: (*) - *Norte, Oeste, Brisa, Litoral Centro, Grande Lisboa*. (**) - *Douro Litoral, AE Transmontana, Douro Interior, Tunel do Marão, Baixo Tejo, Baixo Alentejo, Litoral Oeste, Algarve Litoral*.
Source: DGTF (2010), data referred to December 2009, expressed in current EUR millions

PPP projects projected for the future include the new Lisbon airport, high speed railway links (TGV), as a part of the EU-TENS,[5] the third bridge over the Tagus river and several other road concession projects. The new Lisbon airport, the TGV and the third bridge in Lisbon are vast and interrelated projects that will benefit from EU funding which could cover a significant proportion of the projects' costs.

[4]In these numbers are included data on port authorities that adopt the concession regime - 32 projects under operation.

[5]The concept of Trans-European Networks (EU-TENS) emerged in conjunction with the idea of a Single Market. The goal is to develop modern and efficient infrastructure, linking the various regions of Europe, as a way to promote the freedom of movements inducing economic growth and more employment.

Nevertheless, as a consequence of the current crisis in Portugal, all these projects are on hold and perspectives for the near future do not show a promising picture for new PPP projects. In face of the difficult conditions internally, Portugal may explore the window of opportunity provided by some African countries and Brazil, with their potential markets, enjoying the historical links with these countries. In this respect, the Government Resolution 196/2005, about the cooperation policy between Portugal and the Portuguese-speaking countries in Africa, states that PPP are one of the privileged forms to promote foreign direct investment in those countries. Typically, risks are higher in developing countries, but at the same time, higher risk usually implies higher profitability and Portugal can benefit from the past experience based on long-standing relationships.

Today, more than ever, the choice of the PPP route to develop infrastructure projects is a controversial issue. A great debate started in Portugal, given the heavy cost of these investments, the actual Portuguese budgetary situation and the potential impact on future generations of PPP expenditures. At this purpose, it is worth to mention that apparently, PPP choice is seen by the public opinion as promising or undesirable according to the phase of economic cycle.[6] We argue that an objective assessment should be made for each project with the pros and cons properly evaluated, in an impartial way and free from ideological considerations.

Next, in this section, we conduct a case study research, using mostly qualitative data collected from documentation review, particularly from the analysis of the *Tribunal de Contas* reports and from the Ministry of Finance reports, given the lack of information from another sources. This approach is similar to that used in studies conducted about the PFI experience in the UK, where reports from the National Audit Office (NAO) and from the Treasury (HMT) were used as a fundamental source of information (see Grimsey and Lewis, 2007; Leahy, 2005; Nisar, 2007). An advantage is that, usually, the use of official documents enhance the validity and reliability of the information.

Case studies are appropriate when the goal is to examine contemporary phenomena within a real-life context, to gain detailed knowledge of a complex issue (Yin, 2009). In qualitative research the selection of the cases is purposeful rather than random and is done with the aim of providing an in-depth understanding of the problem under investigation. “Qualitative sampling

[6]Since the late nineties and for several years, Portugal witnessed a boom in PPP projects, reaching now a situation in which, any new project is regarded with distrust and sentenced to fail from the start. For that contributing some of the problems detected in former PPP projects.

is about appropriateness, purpose and access to good information rather than representative and random/probability sampling as with quantitative studies" (Fletcher and Plakoyiannaki, 2010). For our study, we choose PPP projects which are those representative of the Portuguese experience and have the potential to provide usefully insights about the degree of success achieved with PPP. The analysis is focused on four PPP developed in the transport sector, given their relevance in terms of the amounts involved, and we include a fifth case, to mention the programme of PPP in the health sector, although the youth of the projects prevent us from drawing conclusions about the performance of PPP in this sector. Therefore, we focus our analysis in the following PPP:

1. The *Lusoponte* concession
2. The programme of *SCUT* concessions
3. The *Fertagus* concession
4. The *Metro Sul do Tejo* concession
5. The PPP programme in the health sector

Choosing this qualitative approach, several limitations should be emphasized from the beginning. *First*, the case studies analyzed are limited in number, therefore the study is limited in scope. *Second*, generalizations are not possible, and recommendations from the comparison among case studies are limited to the examples used. *Third*, we based our analysis only on documentation review, although, mostly official documents. Using these descriptive cases, the goal is to investigate success factors and the main challenges for each project.

A project's success is something very difficult to measure. In the words of Pinto and Slevin (1988), "there are few topics in the field of project management that are so frequently discussed and yet so rarely agreed upon as the notion of project success". A simplistic approach to be used is to measure success as the accomplishment of the budget and time goals, established on the project plan, and achieving an acceptable level of performance. However, these measures provide only a partial picture and results may be misleading.

In general, PPP deliver projects on-time and on-budget, in what concerns the construction phase. If we move to the operational phase, evidence is mixed concerning performance levels and for some projects, it is still early to make an objective assessment. Next sections develop

each project. For each PPP, a brief history is presented followed by information about the construction and operational phase and in the end, the main challenges and problems are addressed. Specifically focusing the issue of performance in the operational phase, a method to measure the relative efficiency of the SCUT concessions is developed, based on Data Envelopment Analysis. This method can be extended to include other projects in the transport sector, but the unavailability of data prevent us from performing a more exhaustive analysis. This issue is further explored in Section 5.3.

5.2.1 Case study 1 – *Lusoponte* concession

History and background

To build a much needed second bridge over the Tagus river in Lisbon as a solution to the traffic congestion on the *25 de Abril* bridge and in order to promote the economic development of the south bank of the river, the Portuguese State awarded a concession in 1994 to the private partner, *Lusoponte*, a consortium of Portuguese, British and French companies.

The concession contract celebrated between the State and *Lusoponte* had fundamentally the purpose of construction, operation and maintenance of the *Vasco da Gama* bridge and, as well, the operation and maintenance (partly) of the *25 de Abril* bridge. The project was financed using a Project Finance (PF) scheme, in a Design - Build - Finance - Operate (DBFO) contract. Typically, as any concession agreement, at the end of the contract, the assets will revert to the public sector, free of charge. The associated risks of traffic, construction, financing and operation were responsibilities of the private consortium.

In order to attract private partners to this project, the government had decided to include in the concession agreement, the operation and maintenance of the *25 de Abril* bridge. This inclusion had the clear purpose of mitigate the traffic risks of the overall project and in addition, to allow an effect of cross-subsidization, helping fund construction of the new bridge with the tolls collected from the old. The term of the concession had a 33 year-old maximum period, but that could end earlier, if two conditions were cumulatively verified: the integral payment of the contracted loans and when the volume of accumulated traffic flow in both crossings (with a beginning date of January, 1996) reaches 2.250 million vehicles.

The initial concession model was a typical PF, in the sense that the only source for debt repayment and reward all the investors were the cash-flows of the project (the tolls collected in both bridges). No direct payments to the concessionaire by the government, as compensations, were initially planned.

Construction phase

The *Vasco da Gama* bridge had a construction period from February, 1995 to March, 1998. This project was completed in a very tight schedule in order to allow for easy access to Expo'98, the Lisbon World Exhibition. Concerning costs, the initial project had a total value of 897 million Euros financed from the following sources: European Union Cohesion Fund - 319 million Euros (35%) and not reimbursable; EIB loan - 299 million Euros (33%); toll revenues from the *25 de Abril* bridge - 50 million Euros (6%) and others sources, including sponsor's equity and State subsidies - 229 million Euros (26%).[7] Of the project's total cost, about 644 million Euros were for construction, being the remainder, for maintenance costs of both crossings, payment of expropriated land, re-housing and environmental projects. The construction phase was finished on time and according to the forecasted budget.

Operational phase

In a study about the competitive advantage, Lemos et al. (2003) mention that the case of *Lusoponte* may be considered as a successful project, where all stakeholders ranging from the shareholders to the users have expressed satisfaction with the project's quality of service. The conclusion is derived from the following facts: *(i)* from the beginning of the project, an Internal Construction Quality Control Program was implemented allowing the construction phase to end on budget and on time and at the same time, ensuring safety - the continuous cross checking of three entities contribute to this achievement; *(ii)* in the operational phase, this program evolved to a full quality certification for the company according to ISO 2000; *(iii)* finally, both partners, public and private, had a focus on the client needs. On one hand, *Lusoponte* main concern was to reduce traffic congestion and accidents in the *25 de Abril* bridge, increasing the clients satisfaction and reducing the associated costs with accidents, yet in the *Vasco da Gama* bridge, the goal was to increase safety;[8] on the other hand, the public sector had taken measures to meet the clients requirements and for that, also incurred in additional and significative costs.

[7] Available at http://www.lusoponte.pt/ accessed on September 16, 2010.

[8] The two bridges have different characteristics therefore the main concerns regarding the users are also different.

Additional issues

As mentioned in Tribunal de Contas (2007), if unilateral modifications of the initial contract required by the government compromise the profitability of the concessionaire (through significative cost increase or loss of revenue), then the concessionaire had the right to request the restoration of the financial balance. This could be made within the following possibilities: extension of the contract period, extraordinary increase of tolls, the allocation of financial compensation directly by the government and a combination of the foregoing or otherwise agreed by the parties.

In the *Lusoponte* concession, initially, the tolls for each crossing were to be equalized, not taken into account their distinctive attributes and the type of clients each bridge serves. As a result, social disturbance emerged, forcing the government to abandon this requirement for the *25 de Abril* bridge. In addition, for that crossing, the initial concession model did not foresee the introduction of a system of discounts for frequent users and the exemption of tolls during the month of August. Therefore the government had to agree on six compensation packages, required to restore the financial equilibrium of the concessionaire, in relation to the Base Case, to cover losses of revenue resulting from the policy of freezing the toll rates in the *25 de Abril* bridge and from the commercial policy followed.

It should be noted that inversely of what happens in the majority of the transport PPP involving traffic projections, for this project, the projections were pessimistic. The explanation derives from the fact that the construction of the *Vasco da Gama* bridge was expected to have a substitution effect on the traffic that usually uses the old bridge. But, because each bridge serves a distinct type of users and therefore, provides a different service, this substitution effect did not materialize. For instance, in 1998 when the new bridge started its operations, the real traffic exceeded the forecasted in approximately 3.6 million vehicles.

Although, the facts that give rise to losses of revenue in the old bridge (freezing of tolls, discounts for frequent users, exemption of tolls in August), were considered in the new financial agreements, it was verified that the real traffic (being superior to what was expected) had allowed the private partner to benefit from additional revenues and this feature was not properly considered in the agreements. As emphasized by Tribunal de Contas (2005c), the variable of real traffic should have been used as a clawback mechanism, allowing the public sector to share the additional gains obtained by the private consortium. This solution could have been imple-

mented through the adoption of a system of traffic bands, correcting the amount to be paid to the private partner.

In 2001, the Portuguese State and *Lusoponte* signed the Global Financial Rebalance Agreement, where the main changes on the concession model are the following, according to Tribunal de Contas (2005c): the concession period is fixed in 35 years, regardless of the volume of traffic in the two crossings; the assumption of the differentiation principle of the toll rates and commercial policies to be applied in the two crossings; no obligation of the private consortium to contribute to the maintenance costs of the *25 de Abril* bridge; settlement of new financial conditions, that lead to a rise on the financial costs (the State agreed to pay biannually until 2019, a direct compensation to the concessionaire, reaching a global value of 306.22 million Euros).

As a final note, it should be emphasized that the expenditure of public money involved in the *Lusoponte* concession amounts to almost 708 million Euros, of which about 408.4 million Euros (more than half of the public charge) correspond to direct payments, as compensations, to the private partner, to cope with the unilateral modifications of the initial agreements imposed by the government. The remaining of 300 million Euros were subsidies and contributions from the EU. More details on the *Lusoponte* concession can be found in Lemos et al. (2003, 2004) and Tribunal de Contas (2000, 2005c, 2007). A summary is presented below.

Table 5.2: Identification Card - *Lusoponte* concession

SUMMARY	
Identification:	*Lusoponte*
Concession year:	1995
Contract type:	DBFO
Duration:	Until a maximum of 30 years / changed to 35 years
Goal:	Construction / operation and maintenance of the *Vasco da Gama* bridge and maintenance of the 25th April bridge
CAPEX:	897.836 million Euros
Financial arrangements:	Project Finance
PPP Strengths:	• On-time and on-budget construction; • Vasco da Gama bridge is considered one of the biggest and most successful engineering projects in Portugal over the last century, having received international awards; • Important infrastructure asset, providing an alternative to the south traffic
PPP Weaknesses:	Change of the initial status of a free-standing project to a subsidized project, increasing the State burden
Supervision:	InIR

Legend: CAPEX - capital expenditures (source: http://www.dgtf.pt accessed on April 15, 2011)

5.2.2 Case study 2 – SCUT concessions

History and background

In Portugal, the construction, operation and maintenance of highway networks have been systematically outsourced to private entities. Concessionaires were selected through public tendering for construction and operation. Typically the concession period is 30 years, after which the concessionaire's rights and operation of the infrastructure asset terminate, being the asset transferred back to the State. In terms of extension, in December 2010, the Portuguese highway network encompasses 2737 Km from which, 72% are operated on a real toll scheme, 23% in a SCUT regime and only 5%, are not subject to tolls.[9]

The programme of SCUT highways, Portuguese acronym meaning "without charge to the user", was started by the Portuguese government in 1997. These highways are subject to a shadow toll scheme, whereby the government substitutes the final users, making volume-based payments to the concessionaires. The concession model followed is basically a DBFO agreement, with an underlying PF scheme. The particular characteristic is therefore, that the cash flows of the project are paid by the State, providing an apparently free service to users of these roads. Nevertheless, this does not correspond to the reality, as are the taxpayers which ultimately finance the SCUT projects over the 30-year concession period. The rent paid by the State should compensate the concessionaires from the operational and financial costs and also provide a remuneration to the shareholders' capital.

Payments to the concessionaires are computed based on the actual traffic and through a system of traffic bands, to mitigate revenue risk. For low traffic volume, the government payment to the concessionaire, guarantees coverage of basic costs for operation / maintenance and debt service for senior loans. In the second traffic band, debt service for subordinated loans is ensured and finally, profit margins on the sponsor's equity is only paid after the third traffic band is reached. In addition, the government pays lower rates when the traffic volume is higher and the inverse is also true, supporting higher rates for low volumes of traffic. This feature reduces the overall exposure of the project to demand risk. In addition, there is a system of incentives and penalties, which is based on the accident rate and on the roads availability.

Recently, affordability issues concerning the SCUT programme were raised, given the significant cost pressure that it impose on the State Budget. As a consequence, three of the SCUT

[9] http://www.inir.pt/portal/ accessed on June 1, 2011.

concessions (*Costa da Prata, Grande Porto, Norte Litoral*) changed their status to real toll highways, in October 2010. The idea is to end with the shadow toll regime in a near future. Based on information from Tribunal de Contas (2003) and DGTF (2009), Table 5.3 presents a brief summary of the SCUT projects.

Table 5.3: SCUT projects

SCUT project	**Concession year**	**Extension** (KM*)	**Investment** (EUR millions**)	**Financial Structure *****
Beira Interior	1999	177.5	628.3	Debt 90.6%; Equity 9,4%
Interior Norte	2000	156.4	504.1	Debt 98%; Equity 2%
Algarve	2000	130.2	228.5	Debt 83%; Equity 17%
Costa da Prata	2000	104.5	320.7	Debt 91%; Equity 9%
Norte Litoral	2001	113.3	318.6	Debt 73%; Equity 24%
Beiras Litoral e Alta	2001	172.6	718.4	Debt 91%; Equity 9%
Grande Porto	2002	54.7	492.5	not available

Legend: (*)- Source: InIR; (**) - Source: DGTF (2010), referred to December 2009, expressed in current EUR millions (***) Debt: exclusively loans from EIB and other syndicated loans from commercial banks. Source: Sarmento (2010)

Construction phase

Some SCUT projects have experienced cost overruns and delays, mostly related to environmental licensing and with unilateral changes imposed by the public authority. These are also the main reasons leading to contracts' renegotiations and compensation claims. The majority of the projects' problems during the construction phase were a State responsibility. As summarized in Tribunal de Contas (2007), a large number of the SCUT contracts have been renegotiated as a way to compensate the concessionaires for risks assumed by the government or for unilateral changes imposed. In essence, renegotiations were a consequence of changes imposed by the government, for political reasons or due to pressures of local authorities, of delays in obtaining environmental approvals, or related to expropriation processes.

Operational phase

The improvement of the national road network has contributed to increase safety. Portugal is the European country that has had the major decrease in the number of deaths per thousand highway miles. The number of fatal road accidents in Portugal is steadily decreasing from 265 per million inhabitants in 1990 to 147 in 2003 (-44.5%).[10] Other positive aspects are the reduction of transport costs and especially, of the travel time.

[10]http://ec.europa.eu/regional policy/sources/docgener/evaluation/pdf/evasltrat tran/portugal.pdf, accessed on May 20, 2011.

More precisely, about the SCUT concessions, given the complexity and financial dimension of these arrangements, an adequate system of monitoring appears like a critical necessity, with specialized human resources and in number enough, to follow an evaluation program adapted to each phase of the concession and established from the outset. However, according to Tribunal de Contas (2003), insufficient human resources, lacking technical skills and coordination problems between all the entities which are responsible for the supervision of these concessions, contributed to a deficient monitoring program in the initial operational phase of the projects. With the establishment in 2007 of InIR, the supervision and regulatory authority for the road sector, reports are being regularly published on traffic levels and on users' claims.

Nevertheless, reports on the global operational performance of each private concessionaire are still lacking, or if they exist, they are not available to the public. In this respect, a model to ascertain the relative operational performance of each SCUT concession is proposed in Section 5.3.

Additional issues

According to Tribunal de Contas (2008a, 2007), government's payments – compensations, contributions and rents – to all the road concessionaires, using real tolls or shadow tolls, had amounted to 1077 million Euros, until June 2007. From this value, about 867 million Euros correspond to costs with the SCUT concessions, leading to a considerable pressure on the State Budget. In addition, if we consider all the SCUT projects' life, the government expenditure will reach a value near 15560 million Euros (Tribunal de Contas, 2008a).

It is now generally accepted that the affordability assessment was not correctly performed in the planning stage of these partnerships, creating a burden on future generations. As highlighted by Monteiro (2007), the programme of SCUT concessions had not been adequately addressed in budgetary terms, a long term perspective was missing and as a consequence, fiscal problems were created. In the same line, reinforcing this idea, Sarmento (2010) proposed a financial analysis of the SCUT concessions, using the PSC. The author compares the Net Present Value (NPV) of the PPP payments and corporate taxes revenues *versus* the cost of doing the project under traditional public procurement. The results confirm that the choice of PPP in the initial conditions did not add VfM to the public sector. Traditional procurement would have resulted in much less costs (less two or three billion Euros, depending on the discount rate), even when considering that public sector tends to be less efficient.

As a partial solution to this problem, the government decided to replace shadow tolls by real tolls in all SCUT projects. Nevertheless this solution is not fully adopted yet, and only three concessionaires changed to real tolls in 2010, *Costa da Prata, Grande Porto* and *Norte Litoral*.

Nevertheless, it should be noted, that the preparation and launching of any of these partnerships took place lacking a general legal framework for PPP, since it only appeared with the publication of the Decree-Law 86/2003. This fact helps to explain some of the fragilities detected in former PPP arrangements, as mentioned in Monteiro (2007) and in the Decree-Law 141/2006 preamble. More details on the SCUT concessions can be found in Sarmento (2010) or Tribunal de Contas (2003, 2005c,b, 2007, 2008a). A summary of the previous exposition is presented in Table 5.4.

Table 5.4: Identification Card - SCUT programme

SUMMARY	
Identification:	**SCUT programme** (*Algarve, Beira Interior, Beiras Litoral e Alta, Costa da Prata, Grande Porto, Interior Norte and Norte Litoral*)
Concession year:	1999 - 2002
Contract type:	DBFO
Duration:	30 years
Goal:	Construction and operation of near 910 Km of the national road network
CAPEX:	4748.76 million Euros
Financial arrangements:	Shadow toll regime - the State substitutes the users paying tariff payments to the concessionaires based on the actual traffic (measured in a system of traffic bands)
PPP Strengths:	• Improvement of the road national system; •Reduction of the accidents rate and of the travel time
PPP Weaknesses:	• Large delays associated with the absence of environmental approvals; • A clear definition of the projects' objectives was missing, leading to subsequent unilateral changes, by the government; • No careful initial appraisal, neither the development of a PSC, for each project, leading to affordability problems
Supervision:	InIR

Legend: CAPEX - capital expenditures (source: http://www.dgtf.pt accessed on April 15, 2011)

5.2.3 Case study 3 – *Fertagus* concession

History and background

In June 1999 the Portuguese State granted a concession to *Fertagus*, a private consortium entitled of running the railway link between the two sides of the river Tagus in Lisbon. This concession has been attributed for the suburban transport of passengers during a period of 30 years, with the possibility of being renewable. The decision to make a PPP only to the operational phase of the railway was made because the State had supported almost half of the rail infrastructure cost, that amounted to near 500 million Euros, of which about 260 million Euros

were covered by the EU Cohesion Fund. Therefore, the solution adopted was that all the railway infrastructure was a State responsibility and only the operations of the North - South link were attributed to a private entity. Following this option, two different international tenders were developed: one to obtain the rolling material by *CP - Caminhos de Ferro Portugueses* and the other, to the operational phase of the project.

Concerning this last tender, from the three proposals presented, *Fertagus* was selected being the most advantageous proposal, according to the evaluation committee. The estimated private cost of the project had reached 127,4 million Euros, from which 103,5 million Euros were provided by a bank syndicate with a tenor of 20 years and with the remainder, as equity (23,9 million Euros). From here resulting a high leverage ratio, typical to this kind of deals.

The initial model of this PPP was based on a system of traffic bands, which was the main reference to the risk sharing mechanism between the public and the private partner. The mechanism used to mitigate demand risk is basically a government guarantee to the private partner and usually works as follows: if the revenue falls below the lower band, the government pays the concessionaire the difference between the revenues guaranteed and collected and, similarly, if the revenue is above the upper band, the concessionaire pays the government the difference between the collected and guaranteed revenue.

In the particular case of the *Fertagus* concession, the concessionaire has to pay an operational tariff to REFER – *Rede Ferroviária Nacional*, which includes the rent of stations, an occupation tariff for the use of railway complexes (parking, repairing and maintenance of rolling stock) and the infrastructure use. But these payments are only due whenever traffic volume exceeds minimum defined levels. If such levels are not met, which has been the case, the State substitutes the concessionaire in its payment obligation.

Although, initially the project was expected to be financially self-sustainable using PF techniques, and the State financial support only foreseeable in a scenario of low demand, the operational phase has showed that the forecasts of demand were over-optimistic. Thus, the traffic volume never reached the lower limit of the lower band defined, throughout all the first years of operations and as a result, in January 2001 the concessionaire required a renegotiation of the original contract.

According to DGTF (2010) this trend suffered a reversion in 2007, from this year onwards the railway link faces high levels of demand exceeding the initial estimates. In these situations, the concessionaire pays to the State the surplus on the revenue earned over the initial projections of demand. Nevertheless, this does not translate into "real" payments to the State, but contributes to a minor financial effort in the public sector side.

Operational phase

Based on information from Tribunal de Contas (2002, 2005a), we may conclude that the *Fertagus* concession is a notable example of good performance, delivering services with high standards of reliability and quality. In general, it is emphasized the good performance in terms of quality of service, measured with regard to punctuality, comfort and security. Moreover, the results of surveys applied to users, made by a specialized company, have revealed high levels of satisfaction. Between 2000 and 2004, on a scale of 1 to 5, the Global Index of Satisfaction always varied between 4.2 and 4.4, with no attributes having a negative rating. Only in the beginning of the operations, some complaints appeared concerning the number and quality of the related transport services which provide links to the train stations, particularly in the southern shore of the Tagus river.

In the same line, reinforcing the *Fertagus* good quality of service, the reports from INTF[11] which had the task of verify the service levels and evaluate the strict compliance of the concessionaire with the contract terms - particularly focusing on the quality parameters - points out the good results presented. These reports of reliability and punctuality prepared by the INTF provide the basis from which incentives and penalties are computed and then applied to the concessionaire. Finally, in July 2007, *Fertagus* was the first Portuguese railway operator to receive the "Certificate in Railway Security". It was a consequence of the Integrated System for Quality and Security implemented in *Fertagus*, meeting all the requirements of EU legislation.

Additional issues

According to Tribunal de Contas (2007), the State cost involved with the "deficit" of real traffic when compared with the initial traffic projections, reached 55 million Euros. In addition, State costs with advisors involved in the renegotiation of the original contract, were greater than 1.1 million Euros and the government's spending with the new concession contract, signed in 2005,

[11] *Instituto Nacional do Transporte Ferroviário* that was the former regulatory railway entity and has been recently changed to *IMTT - Instituto da Mobilidade e dos Transportes Terrestres*, more specifically to its URF - *Unidade de regulação ferroviária*.

should reach 57.6 million Euros. Furthermore, under the new contract, a leasing operation involving the rolling stock acquisition by the State will amount to approximately 86 million Euros. Nevertheless, the new agreement is more balanced concerning the risk sharing mechanisms and more transparent in the responsibilities' allocation. Some of the positive aspects to be emphasized are the following: abandonment of the system of traffic bands and the full assumption of the demand risk by the concessionaire, more realistic traffic projections, sharing of additional revenue gains, reduction of the concession period, revenues from non-core activities of the concessionaire will also be considered for future agreements on the financial balance, penalties were increased to deal with possible flaws or defective performance of contractual obligations. More details on the *Fertagus* concession can be found in Tribunal de Contas (2002, 2005a,c, 2007). Table 5.5 illustrates the key points.

Table 5.5: Identification Card - *Fertagus* concession

SUMMARY	
Identification:	*Fertagus*
Concession year:	1999
Contract type:	Operational phase
Duration:	11 years (renewable)
Goal:	Operation of the railway link North - South
Investment cost*:	900 million Euros
Financial arrangements:	Project Finance
PPP Strengths:	• Good performance in terms of quality of service (punctuality, comfort and security); • High satisfaction levels by users; • Positive aspects on the environment (fewer carbon emissions and indirectly, reducing traffic congestions)
PPP Weaknesses:	• Over - optimistic traffic projections in the initial phase; • Change of the initial status of a free-standing project to a subsidized project, increasing the State burden
Supervision:	URF / IMTT

*http://www.dgtf.pt accessed on April 15, 2011

5.2.4 Case study 4 – *Metro Sul do Tejo* concession

History and background

Metro Sul do Tejo - MST is a light (above-ground) rail transit system operating in the south bank of the Tagus river. The 30-year concession was awarded to the private consortium *MTS - Metro Transportes do Sul*, in 2002, headed by the *Grupo Barraqueiro* and also including the companies *Teixeira Duarte SA, Mota-Engil SGB, Sopol SA, Siemens SA, Siemens AG* and *MECI SA*, as important shareholders.

The concession assumes a DBFO model for the design, construction, supply of equipment and rolling stock, operation, maintenance and upgrade of the entire MST network. The concession period started on July 2002, with a 3-year period for the construction phase, followed by 27 years of commercial operations. The concession agreement includes the construction of the Long Duration Infrastructures (LDI) and all the works necessary for urban rehabilitation. The MST network is projected on three phases. The first phase, in the municipalities of *Almada* and *Seixal*, consists of 3 lines with 13.5 kilometers, linking *Corroios* to *Cova da Piedade*, *Cova da Piedade* to *Universidade*, and *Cacilhas* to *Cova da Piedade*. The construction period of the first phase is not ended yet, although some lines are already operating (the inauguration date was on May, 2007). The project includes two additional phases, where the rail system will be extended to the municipalities of *Barreiro* and *Moita*.

The first phase of the project development was financed through a State component for the acquisition of lands, rails, stations and other project facilities, that amounts to 265 million Euros, provided either by national (72%) and EU funding (28%). The private partner took the responsibility for financing the rolling material and the ticketing systems, reaching a value near to 55 million Euros. In this contract, private partner revenues include, besides the State reimbursement of the investment on LDI and operating subsidies to cover traffic deficits, the right to all the revenues from the concessionary services and from advertising in the shopping and parking areas of the MST facilities.

Thus and according to Tribunal de Contas (2005c), the vital and distinctive feature of a concession, the assumption of operational risk by the concessionaire almost does not exist in this PPP model, since the traffic risk is, in practice, transferred back to the public partner. The MST concession contract represents a model of PPP not self-sustainable from a financial standpoint, since its feasibility depends entirely of a government guarantee, which leads the State to bear the costs in case of low volume of traffic. More specifically and similarly to the *Fertagus* project, traffic risk is handled through a system of bands, that virtually eliminates the concessionaire's exposure to demand risk – the State pays a subsidy to support the operational deficits if traffic volume is in the lower band. Moreover, if the traffic volume does not reach the threshold of the lower band in three consecutive years, then the concessionaire has the right to terminate the contract, fact that occurring, will have severe financial consequences to the State.

Construction phase

Initially it was expected to have the construction phase ended in 2005, but the project faced several delays and cost overruns. The first problem was with the environmental impact licence. Problems to obtain environmental approval, originated delays in construction and an extra cost of 3,6 millions Euros. Another adverse factor was the unavailability of the municipal lands required to the construction workplaces, that caused significant postponements to the scheduled work and therefore also, the State duty to compensate the concessionaire. All the works were interrupted for at last 16 months and as a consequence, in December 2004, a monitoring committee was formed, in order to renegotiate the concession contract with the MST, since it was at a standstill, due to articulation problems with the local authorities.

These successive delays had serious consequences on the construction costs and on the compensations required by the MST as indemnities for the late beginning of the commercial phase. Several additional works and changes of the original contract terms were imposed by the public sector, in order to satisfy some of the requirements of the *Almada* municipality and solve the impasse created. Globally, these factors led to a set of claims reaching a total amount of nearly 68 million Euros requested by the MST - which was payed in 2009 - and to a global delay of three years.

Operational phase

Concerning the operational phase, it is not possible to perform a global assessment about the quality of the services provided, because the construction phase is still in execution and the rail system is only operating partially. The first data available indicate that the number of passengers is far from the goal of 28 millions passengers per year, but is increasing and has not stabilized yet (it is around 600.000 passengers per month, from data available in May, 2009). Concerning the users' satisfaction, the balance seems to be positive, as it is, moreover, the balance in terms of reliability of the system - number of failures, efficiency and punctuality. Some of the advantages pointed by the users are comfort, travel speed and it is an environmental friendly system. The problems pointed are related with the lack of security and parking areas.

Additional issues

As reported in Tribunal de Contas (2007), the State cost will probably reach 300 million Euros, with the construction of parking areas in the city of *Almada* being the largest share of the additional costs. In a public sector perspective, it is essential to perform a cost-benefit analysis

to all the claims of systematic "additional works" from the local authorities and populations, avoiding that way, the negative impact that successive changes bring to the public accounts. An additional factor increasing the uncertainty inherent to public sector future payments is that the renegotiated contract involves the State compensation to the private partner as a result of the "real" traffic and for that purpose, lack any forecasts for such charges.

According to Tribunal de Contas (2006), we may summarize the MST problems with the following causes: first, the multiplicity of agents in the public sector side concerning project negotiations, involving three successive governments; second, deficient articulation between the different entities involved in the project; third, the absence of a legal framework for PPP when the initial contract was settled and finally, the conduct of local authorities that tried to obtain additional benefits affecting the normal project development. More details on the *MST* concession can be found in Tribunal de Contas (2005c, 2006). As a summary, Table 5.6 shows the main characteristics of the *MST* concession.

Table 5.6: Identification Card - *Metro Sul do Tejo* concession

SUMMARY	
Identification:	*MTS – Metro Transportes do Sul*
Concession year:	2002
Contract type:	DBFO
Duration:	30 years
Goal:	Design, construction, supply of equipment and rolling stock, operation, maintenance and upgrade of the entire MST network
CAPEX:	320,649 million Euros
Financial arrangements:	State component, 265 million Euros for LDI and private financing of 55 million Euros, for rolling material and ticketing systems. The State pays a subsidy to cover traffic deficits (through a band system) Private revenues include concessionary services and advertising.
PPP Strengths:	• Good performance in terms of the quality of service, • Positive aspects on the environment (fewer carbon emissions and indirectly, reduction of traffic congestions)
PPP Weaknesses:	• Several delays and cost overruns in the construction phase due to additional works, environmental approvals, and expropriation processes; •Deficient articulation with the local authorities
Supervision:	IMTT

Legend: CAPEX - capital expenditures (source: http://www.dgtf.pt accessed on April 15, 2011)

5.2.5 Case study 5 – PPP in the health sector

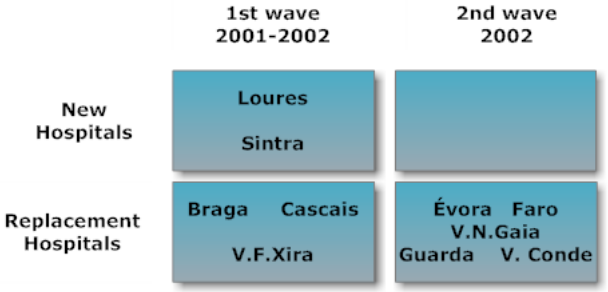
History and background

The Portuguese government has widened its PPP activity to include the health sector, by launching tenders for projects related to the construction, operation and maintenance of public hospitals. The programme of the first wave hospitals was launched in 2001, including the hospitals of *Loures, Cascais, Braga, Sintra* and *Vila Franca de Xira*. The PPP model used was complex and innovative, implying two different partnerships: one responsible for the construction and management of the hospital facilities, with a time horizon of 30 years and the other, responsible for providing clinical services, for a much shorter period (usually 10 years). Portugal was a pioneer in the introduction of this model, because although the UK already used PPP in the health sector, their model encompasses only the component of the hospital building (construction and operation / maintenance).

From the beginning it was clear that this kind of partnerships were far from easy to structure, as the arrangement implies risks, responsibilities and payments involving two different concessionaires, one providing the hospital accommodation for a long period and another providing clinical services, with a much shorter time horizon. As already mentioned, core services in health seem not to be a suitable sector for the PPP model, because this sector is characterized by a high degree of uncertainty associated with the rapid advances in technology and in the medical science. In situations of high complexity and uncertainty is difficult to define completely the output specifications from the outset, a pre-requisite for the PPP contracts.

In 2002, it was announced the second wave of PPP hospitals, with 5 hospitals: *Algarve, Évora, Guarda, Póvoa do Varzim / Vila do Conde* and *Vila Nova de Gaia*, to replace the existing ones. A salient feature of these PPP is that they envisage the private partner only to manage hospital facilities, adopting the UK model. As mentioned in Monteiro (2005), with this extensive programme of 10 hospitals, an annual payment of around 0.5 percent of the GDP was initially predicted. At the same time, because these hospitals are expected to be more efficient and replace spending on old hospitals, they could help restrain public expenditures within the public health care service (*Serviço Nacional de Saúde*). Figure 5.3 illustrates the PPP health programme.

Figure 5.3: PPP programme in health



Source: Simões (2004)

Without international references and because it had been the first Portuguese experience in the health sector, this programme faced several challenges. *First*, delays in tender procedures, mainly in the bids assessment, which lasted between 11 to 23 months, when the initial forecasted period was only 5 months. *Second*, an excessive bureaucratic charge with some rigidity in contractual specifications. *Third*, the tender for the *Sintra* hospital was canceled and in the case of *Loures*, the State extinguished the first tender. Four years later, a new tender procedure was launched for the same project but with a reduced private sector interest, lacking an effective competition. Several rules exist to sustain bidders interest. For instance, efforts to keep bidding costs low, production of clear bidding requirements and a reasonable schedule for all the process. The Portuguese health programme failed in all these aspects. In addition, costs with advisors to develop the health programme achieved the value of 20 million Euros. But also the positive aspects of the programme should be mentioned – the health PPP programme was the first to use systematically the PSC (Moreno, 2010).

From the first PPP programme in health, the *Cascais* hospital started its operations in 2010, but *Braga* and *Loures* are still in the construction phase, and *Vila Franca de Xira* in the tender phase. According to DGTF (2010), two second wave hospitals namely, *Lisboa Oriental* and *Central do Algarve* are in the tender phase. More details on the PPP programme in the health sector can be found in Simões (2004) and Tribunal de Contas (2009b).

5.3 A relative assessment of the SCUT operational performance

Performance and efficiency are difficult to measure. In this section, Data Envelopment Analysis (DEA) is described as a potential tool to access the relative performance of homogeneous units and a practical application is developed using data on the SCUT projects.

DEA is a non-parametric approach based on the idea of technical efficiency, measured by the ratio of output to input. It allows the identification of the efficient and inefficient units in a comparison of each unit with *its peers* (within the group). This programming technique was developed by Charnes et al. (1978) and since then it has been used to assess efficiency in areas such as health, prisons, courts, schools and universities and more recently, transit and even banking.

Following closely the exposition of Santos and Dul (2000), in DEA, efficiency (h_j) of a specific decision making unit (DMU_j) is defined by the ratio of the weighted sum of its N outputs (y_{nj}) and a weighted sum of its M inputs (x_{mj}),

$$h_j = \frac{\sum_{n=1}^{N} v_{nj} y_{nj}}{\sum_{m=1}^{M} u_{mj} x_{mj}} \tag{5.1}$$

where, x_{mj} is the m^{th} input; y_{nj} is the n^{th} output; v_{nj} and u_{mj} are the weights chosen for each DMU_j, in order to maximize its efficiency h_j. Several restrictions should be added to the maximization problem: first, weights must be strictly positive; second, for scaling purposes efficiencies must not exceed 1 or 100%, and finally, to avoid an infinite number of possible solutions the denominator of the previous equation, must be 1 or 100%. As a summary, the maximization problem for each DMU under analysis is,

$$Max \quad h_j = \frac{\sum_{n=1}^{N} v_{nj} y_{nj}}{\sum_{m=1}^{M} u_{mj} x_{mj}} \tag{5.2}$$

s.t.

$$v_{nj} > 0 \quad u_{mj} > 0 \qquad for \quad m = 1, ..., M \quad n = 1, ..., N \tag{5.3}$$

$$h_j = \frac{\sum_{n=1}^{N} v_{nj} y_{nj}}{\sum_{m=1}^{M} u_{mj} x_{mj}} \leq 1, \qquad for \quad j = 1, ..., J \tag{5.4}$$

$$\sum_{m=1}^{M} u_{mj} x_{mj} = 1 \tag{5.5}$$

The advantages of DEA include its ability to accommodate a multiplicity of inputs and outputs (that may be expressed in very different units) and no prior establishment of rules for the weights are necessary. DEA compares the relative performance of each DMU with the "best" performance. In addition, DEA allows constant returns to scale, as well as, decreasing and increasing returns to scale.[12]

In contrast, several limitations may be pointed, namely, the results sensitiveness to the selection of inputs and outputs, it is not possible to test for the best specification and the number of efficient DMU on the frontier tends to increase with the number of inputs and outputs variables (Berg, 2010). As a rule of thumb, usually is required that $J > 3.(N + M)$, with J as the total number of DMU.

Since 1992, when the first papers applying DEA to public transportation appeared, this technique has been increasingly popular for comparing transit organizations with each other. We propose to apply DEA to compare the relative efficiency of each SCUT concession with *its peers*. With this goal, next section details the models and variables used, Section 5.3.2 presents the results obtained.

5.3.1 The model

The right choice of the inputs and outputs is critical for the DEA model and naturally some connection between the input and output may exist. Following similar works on transport systems (Barnum et al., 2007; Santos, 2008) and taking into account the data availability, the following inputs and outputs were chosen, combined in two different models, to measure the relative operational efficiency of the SCUT concessions, for the years of 2008, 2009 and 2010:

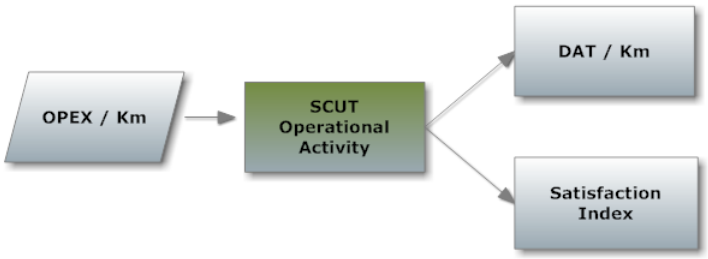
- OPEX/Km - is the amount of the operational expenses divided by the number of Kilometers;

[12] Constant returns to scale implies that if we increase inputs by λ, outputs increases by that same proportional change. If output increases by less than that proportional change, we have decreasing returns to scale and the inverse, leads to increasing returns to scale.

- DAT/KM - is the daily average traffic (in an annual basis) divided by the number of Kilometers, as a proxy for the number of users;
- Satisfaction Index - measured by the inverse of the number of claims received.

Data were obtained for each SCUT concession and year, from *Relatório de Reclamações 2010* (INIR, 2010) and from the Case Base of the SCUT concessions, also from InIR. We use the estimated value of the operational costs drawn from the projects' Case Base, because actual values of the operational costs are not publicly available. Although it was not a very accurate procedure limiting our results interpretation, the DEA analysis was developed in order to give an idea of the scope and range of this method and providing useful insights about the relative performance level. The first model purposed is the following:

Figure 5.4: DEA - Model 1



Because the data available is related to 7 concessions, and better results are provided when the total number of DMU, at least, triplicate the number of variables, the model was re-estimated using only one input and one output (Figure 5.5). Several other inputs and outputs may be considered, for instance, capital expenditures (CAPEX) as an example of input or the accident rate, as an output. But, the consequence of increasing the number of variables, is that the optimization routine will put the majority of the DMU on the efficiency frontier, preventing a proper analysis.

Figure 5.5: DEA - Model 2

In both models constant returns to scale were assumed and an input orientation, meaning that the models searched the minimization of inputs for the given level of outputs. The other possibility was to choose output orientation, where the goal is to maximize outputs maintaining constant the level of inputs. In what concerns the SCUT projects or any other public transport system, reduction of the operational costs assume particular relevance, justifying our choice.

5.3.2 Results

All the results were obtained using STATA 11 statistical software. For the first model, using one input (OPEX/km) and two outputs (DAT/Km and Satisfaction index), the following results are obtained.

Table 5.7: Efficiency level of the SCUT concessions - Model 1

Model 1	**2008**		**2009**		**2010**	
	Rank	Efficiency	Rank	Efficiency	Rank	Efficiency
Norte Litoral	1	1.000	1	1.000	1	1.000
Interior Norte	7	0.154	7	0.517	7	0.642
Grande Porto	4	0.788	4	0.863	4	0.855
Costa da Prata	3	0.923	3	0.991	3	0.992
Beiras Litoral e Alta	6	0.256	6	0.590	5	0.847
Beira Interior	1	1.000	5	0.751	6	0.696
Algarve	5	0.697	1	1.000	1	1.000

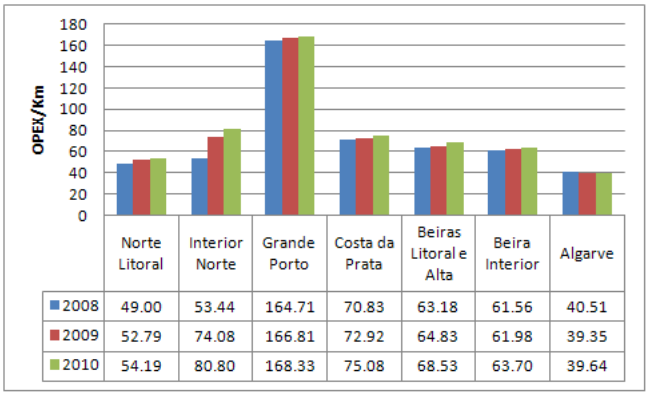
Taking into account the SCUT universe, the most efficient concession in all the years is the *Norte Litoral*, achieving the score of 1 or 100% and the less efficient, is the *Interior Norte*, when compared with "its peers". Considering only one input, operational costs per Km, and one output, the number of users per km, the results of Table 5.8 are obtained.

Table 5.8: Efficiency level of the SCUT concessions - Model 2

Model 2	**2008**		**2009**		**2010**	
	Rank	Efficiency	Rank	Efficiency	Rank	Efficiency
Norte Litoral	1	1.000	1	1.000	1	1.000
Interior Norte	7	0.137	7	0.108	7	0.123
Grande Porto	3	0.788	3	0.863	3	0.855
Costa da Prata	2	0.923	2	0.991	2	0.992
Beiras Litoral e Alta	5	0.244	5	0.250	5	0.255
Beira Interior	6	0.192	6	0.198	6	0.206
Algarve	4	0.697	4	0.733	4	0.748

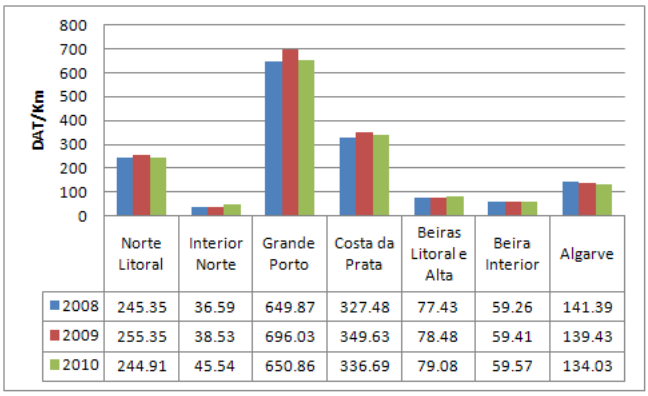
A consistent pattern is showed in the three years under analysis, the rank is the same across years with some minor changes in the efficiency scores attributed to each SCUT. More efficiency appears in the *Norte Litoral, Costa da Prata* and *Grande Porto* concessions, notably the ones that change their status to real tolls highways in October, 2010. Less efficiency is exhibited by the *Interior Norte*. A close analysis of the inputs and outputs highlights explanations for the results provided by the DEA analysis.

Figure 5.6: Operational costs per KM



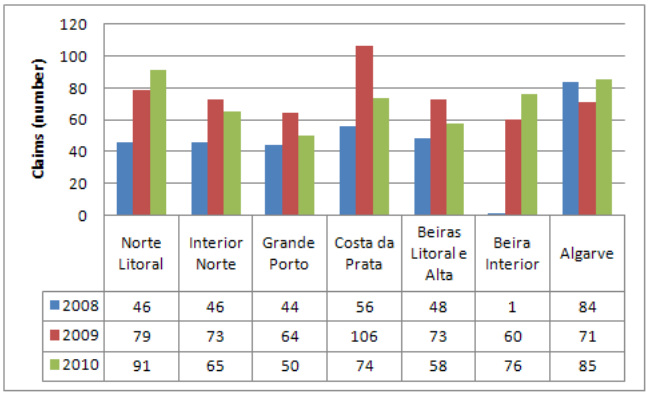
The operational costs are higher for the *Grande Porto* concession, they are twice the value of the second more expensive concession in operational terms, *Costa da Prata* or *Interior Norte*, depending on the year we choose to perform the analysis. But at the same time, *Grande Porto* serves a larger pool of users, as the next figure shows.

Figure 5.7: Users per KM



In respect to the number of claims, in general, 2009 records higher numbers (Figure 5.8). *Costa da Prata* has the higher number of claims in this year (106). If we move to 2010, then the highest level of claims is reached by the *Norte Litoral* concession. A more detailed analysis reveals that *Beira Interior* has just one claim in 2008, what explains the efficiency score of 100% in 2008. This outlier observation has affected the results obtained by the DEA analysis. Since DEA is an extreme point technique, outliers arising from potential measurement errors can cause significant problems.

Figure 5.8: Number of claims



Using a particular ratio or indicator to access performance levels, may be misleading and inaccurate. In addition, the choice of what ratio or indicator to use, may be a problem and usually depends on the entity performing the analysis. DEA has the advantage of providing an overall and objective measure of the relative efficiency of each DMU, among similar units. Our analysis of the SCUT concessions, allow the identification of the *Norte Litoral* as the most efficient. But

of particular concern should be the SCUT with the lowest scores, namely *Interior Norte* and *Beira Interior*. A careful analysis of the underlying reasons for that scores should be developed, in order to implement plans of action to improve the operational performance.

This empirical exercise showed a possibility to measure efficiency in the SCUT concessions (an universe of seven PPP), but can be extended to include more road concessions, and even further to different sectors, as long as, the availability of data will permit. Next section summarizes the main conclusions about the Portuguese experience.

5.4 Main conclusions

The description of the five PPP projects and programmes stresses important key issues. Although, it is worth to recall, that generalizations to the Portuguese PPP universe are not possible and only conclusions about the particular projects under analysis could be drawn.

First, it is not possible to know whether these projects could have achieved these or better results using a different procurement route. Nevertheless, as noted by Tribunal de Contas (2009a), several projects undertaken directly by the Portuguese government face important delays and significant cost overruns. In a study of five projects, it was found that cost overruns vary from 25% and 295%, above the cost plan agreed at financial close, and face delays from 1,4 to 4,6 years.

Second, as a general perception and similarly to what happens in other European countries (for instance, the United Kingdom), PPP seem to perform well in the construction phase compared to traditional public procurement. Monteiro (2005) argues that the Portuguese history with PPP shows their effectiveness in rapidly developing infrastructure assets and in improving the quality of services. In general, PPP are perceived as providing effectiveness in the provision of good-quality infrastructure and services. But efficiency is not always assured and affordability is not guaranteed.

From our previous analysis this idea is reinforced. The mentioned effectiveness comes at the expenses of some public sector inability to deal in the long run with these partnerships. On one hand, given the long tenor of such projects, long-term budgeting is necessary to correctly evaluate the fiscal implications (affordability is a key concern) and on the other hand, it is essential to manage the long term relationship between the public and the private partner, using the appropriate level of monitoring and sanctioning and also, performing an in-depth analysis of the costs and benefits to any changes of the original agreements. To accomplish this, it is necessary to create specific institutions focused on PPP deals, in order to develop the necessary expertise, know-how and to retain the long experience of Portugal with PPP. This aspect is also systematically mentioned in *Tribunal de Contas* Reports and remains unsolved, see for instance, Tribunal de Contas (2009b) when is mentioned that Portugal used an experimentalist approach with all the health PPP programme. At this purpose, Moreno (2010) stresses that although Portugal has some institutional structures to deal with PPP arrangements, a truly PPP agency does not exist, with the capacity to cover all the Portuguese PPP universe.

Concerning the transport PPP projects under analysis, traffic risk mitigation is still a challenging aspect. As emphasized by Estache et al. (2007), particularly for transport projects, forecasts of revenues, traffic and economic activity continue "to be overoptimistic, so that best case scenarios often continue to be sold as Base Case scenarios, helping to justify the investment decisions". Following this general trend, overoptimistic traffic projections were used in the *Fertagus* and *Metro Sul do Tejo* concessions, being the *Lusoponte* a notable exception. Therefore, payments to the concessionaires achieved higher levels than what was firstly envisaged. For transport projects it is not possible to establish from the outset take-or-pay or fixed-price contracts, differently to project financing in other sectors. As a result, demand risk is a critical issue in all projects. Even with reasonable forecasts, demand can be severely affected by factors like competition from other transport modes, changing usage patterns and macroeconomic conditions (e.g., fuel prices). Demand risk can be hedged through contracts with a flexible duration or, as used in the Portuguese PPP model, through government guarantees implicit in the definition of a system of traffic bands.

Several institutional improvements are being developed, particularly in the procurement process with the development of a gateway process (explained below), the enhancement of competition and making the PSC computation mandatory for all the projects, as a critical test to proceed to the PPP route. In addition, an integrated information system to deal with PPP in all their life cycle is under development. The main improvements are detailed next.

- In the early days of PPP projects, Portugal does not had a system to control PPP commitments creating, as a consequence, budgetary problems. More recently, Portugal developed an appropriate assessment methodology, mentioned in Monteiro (2007) as a gateway process, allowing a more consistent approach to PPP appraisal and affordability. More precisely, the Finance Minister has the power to stop or suspend a PPP project or programme, if some conditions are not met and this is done at specific stages (the "gates") of preparing and negotiating the project. Typically, the approval or rejection by the Finance Minister is required at the end of the pre-procurement phase and at the end of the procurement phase. Hence, the project only proceed in each stage, if the criteria of efficiency and fiscal sustainability are met. In addition, for each possible renegotiation, the Finance Minister has to approve the renegotiated contract. For more details on the Portuguese gateway process, see Monteiro (2007).

- Competition is now ensured in PPP projects. The procurement phase involves an international public tender, with procedures similar to those used in major public works, including advertising obligations. It should be emphasized that the PSC is the limit value for contracting, if all bids exceed this threshold, the government has the right to cancel the call and as already mentioned, projects with only one bidder are cancelled.

- An information system is being developed by DGTF and *Parpública*, with the goal to collect all the relevant information about the Portuguese PPP universe. This database will constitute on a very short term, a valuable tool for studying and disseminating regular information on this subject.

A positive aspect of PPP is that this form of procurement, typically, has high visibility when compared with other procurement methods. A fundamental contribution to the enhancement of all the PPP framework is given by the *Tribunal de Contas* Reports, ensuring more transparency on projects contracted in PPP schemes with a higher disclosure of information, when compared to other major projects undertaken directly by the State. Additionally, the high leverage levels of the majority of PPP lead to a more careful project evaluation and risk assessment, particularly from lenders.

As a final note, recently governments and their PPP policies are in the "line of fire" of the public opinion as a consequence of the deficit crisis. In this scenario, an objective perspective must be adopted, far from ideological considerations. PPP exhibit several successful stories, particularly when their choice is based on efficiency and effectiveness criteria, and not as a fiscal instrument. While it is true that the option to structure a project under a PPP is appealing to the government as a mechanism to alleviate it from some of its traditional tasks, it is equally true that this option brings increased responsibilities and new challenges on the management and control of such arrangements.

Apart from the Portuguese reality, which country factors foster PPP development? The answer to this question is the gist of the next chapter.

Chapter 6

Determinants of PPP in infrastructure

The main goal of this chapter is to perform an empirical analysis of the cross-country determinants of agents participation and of investments in infrastructure Public Private Partnerships (PPP) in developing countries. More specifically, the role of different risk dimensions is analyzed and the risk reduction effect of the participation of Multilateral Development Banks (MDB) is explored.

This chapter is organized as follows: Section 6.1 discusses the background and justifications for the empirical study proposed. Section 6.2 highlights the recent trends on infrastructure PPP to developing countries. Section 6.3 presents the hypotheses to be tested and proxies used as measures of different risk attributes. In Section 6.4, we discuss the methodology presenting the econometric models. Section 6.5 is devoted to the data and variables. Section 6.6 shows the results, comparing our findings with related studies. Finally, Section 6.7 presents a summary, as well as, suggestions for further research.

6.1 Introduction and background

Good quality infrastructure assets and services are crucial for countries' competitiveness, economic growth and to improve the living standards of the population. Particularly for developing countries and transition economies, access to affordable infrastructure services, such as electricity and drinking water, is an important determinant of the welfare level of a country's population. But in these countries, the infrastructure gap is more pronounced, with huge infrastructure investment needs and lacking the necessary financial resources.

It is widely recognized that much more investment will be needed in developing countries, to achieve the Millennium Development Goals (MDG), specifically, the goal of reducing poverty.[1] In this respect, the private sector investment has a fundamental role to play, inducing economic growth and poverty reduction. As mentioned before, the private sector involvement will bring more funds, expertise and efficiency to the development of projects in several essential areas, like energy, telecommunications, transport (roads, tunnels, bridges, railways, airports) and water/sanitation.

One way of increasing the private participation in infrastructure projects is through PPP. These partnerships are a worldwide phenomenon, spread in developed countries, but also in developing ones. Nevertheless, the implementation of PPP in these countries is a challenging task, facing several limitations. For instance, according to Pessoa (2006), many developing countries face problems in adopting an adequate regulatory framework, have underdeveloped capital markets and non-competitive industries and are dependent from investments made by a few of international and large companies, resulting in a lack of negotiation power. Therefore, political, legal, social, economic and financial risks may be even more important in developing countries than in developed ones and the same conclusion seems to be evident about the participation of MDB in PPP arrangements, for those countries.

As explained in Section 3.3, the participation of MDB in infrastructure projects plays a crucial role, enabling fund raising, particularly from private agents, and acting like an additional guarantee for the viability of the project (mechanism of risk reduction and credit enhancement). Concerning developing countries, these features are even more relevant. At this purpose, Sorge and Gadanecz (2004) add, that some of the important benefits that arise from the special relationship between MDB and the host governments, include "the resolution of any problems that might arise in the regulatory or policy environment and put a project in danger. It can also ensure collateral protection in countries where the legal system is not very reliable".

From the combination of developing countries risks with the risks that are inherent to infrastructure investments we may conclude, at first glance, that such ventures were not appealing for

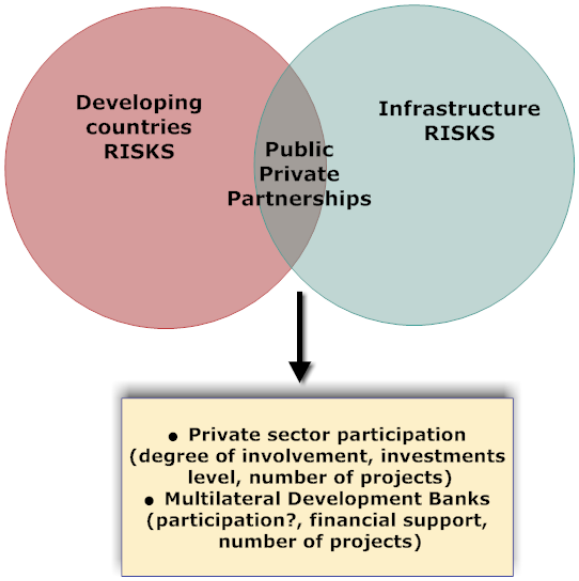
[1]The MDG were established in 2000, when leaders of countries from the entire world committed to devote every effort in order to achieve eight development goals by 2015. They include reducing extreme poverty and hunger, reducing child mortality, improving maternal health, achieve universal primary education, fighting disease epidemics and developing a global partnership for development (en.wikipedia.org/wiki/Millennium Development Goals, accessed on February 19, 2010).

private investors. But the reality shows another picture. Since the 1990's there has been a huge rise in Foreign Direct Investment (FDI) and other types of investment in infrastructure, at a global level, but also in developing and transition economies. According to Fay et al. (2010), FDI flows to developing countries, related to infrastructure, accounted for about one-third of all flows in the early 1990s. Ramamurti and Doh (2004) present the following explanations to this exponential growth - the end of natural monopolies making regulation less needed, the prospect of quick profits for first-movers and the use of Project Finance mechanisms to reduce the risks. Another aspect mentioned by those authors is the adoption of favorable legal measures and the end of outright expropriations, creating a new climate for FDI.

From all the previous exposition, some questions emerge concerning infrastructure PPP in developing countries: (1) *Which risk is the more influential affecting the degree of private sector participation in a PPP?* (2) *What country factors affect the probability of a MDB participation in a PPP?* (3) *What are the main determinants of the number of PPP projects?* (4) *What are the main drivers of the amount of PPP investments?*

Next figure highlights the framework purposed for the empirical study, assessing the determinants of infrastructure PPP in developing countries.

Figure 6.1: Empirical study framework



The empirical study is developed of the cross-country determinants of private sector and MDB participation in PPP, using data between 1990 and 2007, from the World Bank's Private Participation in Infrastructure Database (PPI), available at http://ppi.worldbank.org. The purpose is to test empirically how different risk dimensions affect the agents' participation. In addition, to explore these issues further and ascertain the risk mitigant effect of MDB participation in PPP arrangements, the same explanatory variables are tested to explain the total number of PPP projects (per country/year); the number of PPP projects with MDB participation (per country/year); the investment value of PPP projects (per country/year); and the financial support provided by MDB to PPP projects (per country/year).

While there have been some studies examining the determinants of FDI to developing countries (see Neumayer and Spess, 2005; Rose-Ackerman and Tobin, 2005; Singh and Jun, 1995), or of MDB flows (Neumayer, 2003), few empirical studies address the particular topic of infrastructure projects. Related literature also includes the study of the risk reduction effect of the participation of MDB on the credit spreads of infrastructure loans (Kleimeier and Megginson, 2000; Sorge and Gadanecz, 2004).

Particularly focusing on the number and investments' value of PPP projects to developing countries, to the best of our knowledge, the first empirical attempts are provided by Banerjee et al. (2006) and Hammami et al. (2006). Both studies examine the effects of several institutional variables on the number of projects and their value. Therefore, using these studies as a starting point, we extend their work in several directions.

- First, only projects that share the main characteristics of PPP are considered and not, the full database available. Projects that are management and lease contracts and full privatizations are therefore excluded.[2]
- Second, more recent data is used, from 1990 to 2007, in the expectation that the use of more recent data will add positively to the research;
- Third, new explanatory variables (indicators of the degree of social and financial development of a country) are considered, as well as, new methodological approaches.

[2]This aspect was also emphasized by Pessoa (2008), mentioning that not all forms of private sector involvement in public provision are PPP.

Finally and not yet studied, as far as we know, the main contribution of the empirical study is the identification of which risk factors are more relevant in determining the private sector participation in infrastructure PPP, as well as, the MDB participation in such projects.

The goal is to test simultaneously a vast variety of variables, proxies for the different risk dimensions of a country, in an attempt to provide a more complete "picture" of the drivers of infrastructure flows and of the participation of the different agents to developing / emerging markets. Such an aggregate analysis is relevant because different risk dimensions interact with each other. If we focus on a particular dimension, the results will be probably misleading and inaccurate.

In a context of a worldwide financial crisis, these topics are gaining relevance and are of major importance to all engaged in the PPP markets, particularly governments, private sector investors, MDB and the population in general. Two controversial trends emerge, on one hand, infrastructure investments are seen as a stimulus to economies given their effects on productivity and linkages with other sectors (usually integrate "anti-crisis packages" promoted by governments), and on the other hand, increasing pressures exist on governments to reduce the fiscal deficit, impairing spending on infrastructure. In addition, focusing emerging markets, international banks are adopting a more conservative attitude, retreating to preserve capital. In this scenario, MDB are being called to fill this financial gap and a more active role is now required, creating more effective partnerships with the private sector.

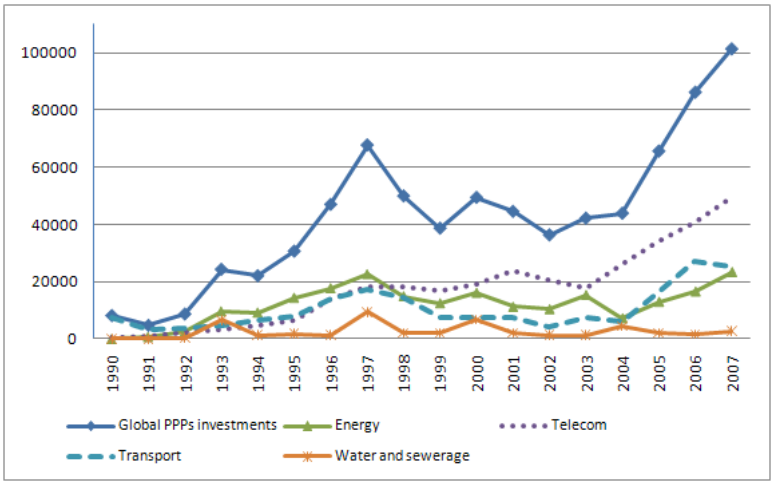
Next section presents the recent trends in infrastructure PPP to developing countries, including a brief reference to the effects of the recent financial crisis, although outside the time span of our empirical analysis.

6.2 Trends in infrastructure PPP

Recent trends on infrastructure financial flows report that private investment (contrary to public investment) is growing rapidly throughout the world, but especially in emerging markets and developing countries. Some numbers and figures to illustrate this idea are given next (see Fay et al., 2010; Forrester and Tillett, 1998; Ramamurti and Doh, 2004).

As a general trend, private participation in infrastructure has increased steadily since the 1990s, with a six-year hiatus as a result of the Asian crisis, recovering and reaching a peak in 2007. According to the PPI Database, in the past the peak of the private infrastructure boom was 1997, thereafter a number of factors led to a reduction in the number and amount of projects, namely, the financial crisis of 1997-98, the slowdown in economic activity, the bursting of the dot-com and telecommunications bubbles and also, the fact that privatization was a one-time phenomenon. More recently and after a downward trend from 1998 to 2003, private investment in infrastructure projects increase from 2004 to 2007. Investments became more concentrated in sectors like telecommunications and energy who lead the recovery, followed by transport with investments stabilized over the last three years. The sector with a traditionally minor expression is still the water and sewerage sector (see Figure 6.2).

Figure 6.2: Total PPP investments* per year and sector

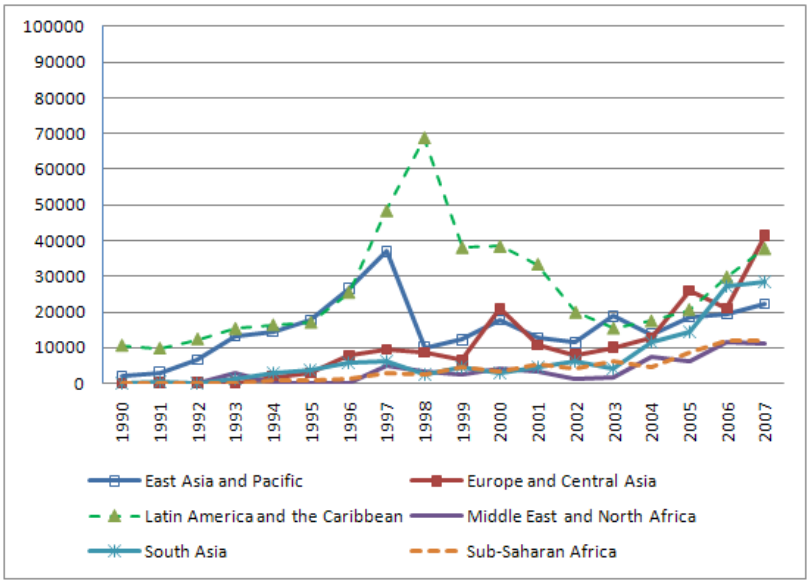


* in current US$ millions

Source: Based on PPI Database

Geographically, after several years of the Latin America and the Caribbean dominance, from 1996 until 2002, investments from 2003 onwards, are more evenly spread across all developing regions (see Figure 6.3).

Figure 6.3: Total PPP investments* per year and region

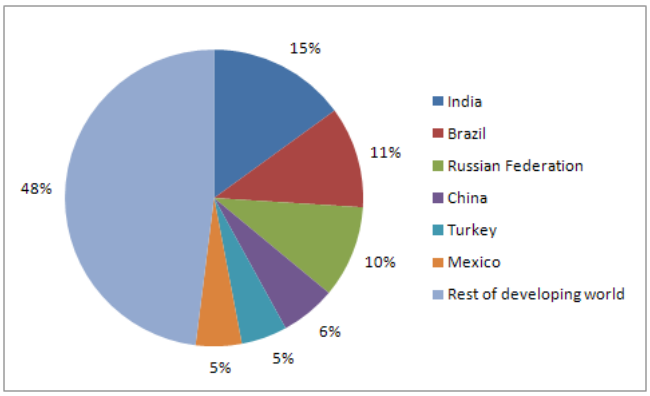


* in current US$ millions

Source: Based on PPI Database

Nevertheless, the balance between regions exhibited in the last figure, hide huge differences concerning countries. The top six countries had accounted for about half of private infrastructure flows in the last few years, reaching near 60% in 2008, as illustrated in Figure 6.4.

Figure 6.4: Geographical concentration of investments to infrastructure projects in 2008



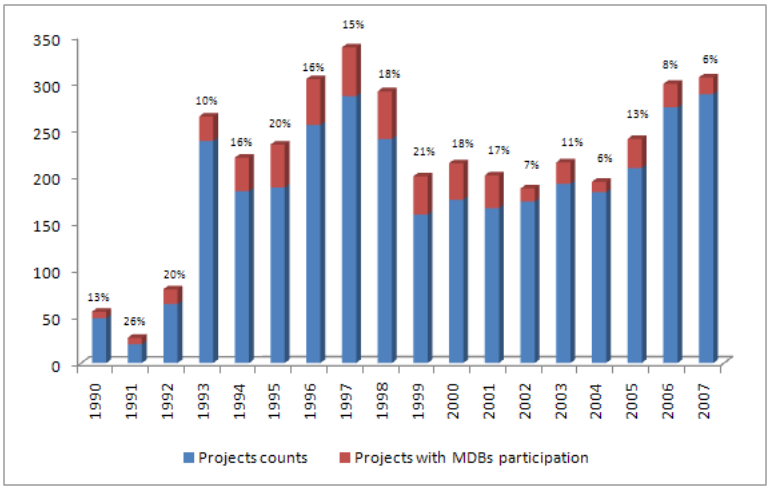
Source: World Bank and PPIAF

The so-called BRIC countries of Brazil, Russia, India and China, plus Mexico and Turkey, all emerging economies, have concentrated investments over the last years. Izaguirre (2010) ex-

plains that one of the consequences of the recent financial crisis, is that the number of projects has shrunk although overall financial flows have remained relatively steady, but investments were concentrated in these emerging countries. Moreover, if the BRIC countries, plus Turkey, were excluded, investments would have fallen by 32% in 2009, comparing to 2008.

The total count of infrastructure PPP projects also raised from 2004 to 2007, accompanying the investment values. Particularly about MDB participation in the total number of projects, the rate of participation as oscillated between 26% in 1991 and 6% in 2004 and 2007, with an average annual value of 13% during the period of 1990-2007 (see Figure 6.5).

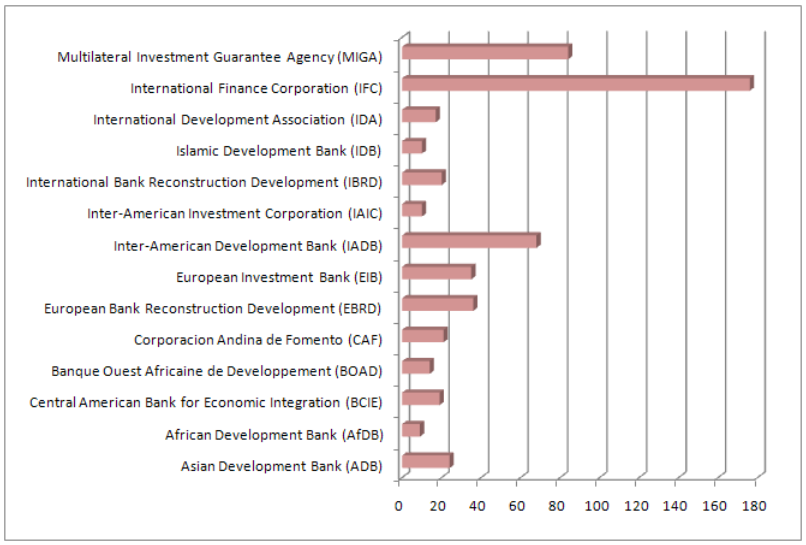
Figure 6.5: Number of PPP projects



Source: Based on PPI Database

Distinguishing between MDB, the more active role is played by the International Finance Corporation (IFC) and by the Multilateral Investment Guarantee Agency (MIGA), with a participation in 176 (32% of the total count of projects with MDB participation) and 84 (15% of the total) projects, respectively, from 1990 to 2007, as highlighted by Figure 6.6. The IFC belongs to the World Bank Group and its main activity is to provide financial support (loans and advisory services) to private sector in less developed countries. Yet MIGA, also a member of the World Bank Group, has the main activity of providing guarantees to projects financially and economically viable and that are consistent with the development objectives of the countries.

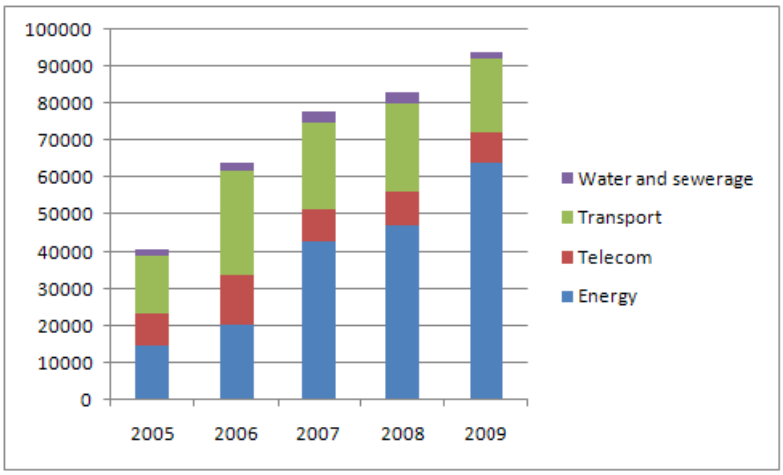
Figure 6.6: Number of PPP projects with MDB support



Source: Based on PPI Database

Although outside of the time span of the present empirical study, it should be mentioned that the environment for PPP projects has been impacted by the recent financial crisis, particularly through a selectivity effect, concerning the type of projects and countries where to invest, and through more difficult and stringent financial conditions. As a result, some planned projects are still being delayed, restructured, or, to a lesser extent, canceled. Albeit this environment, global investment commitments to new PPP projects in developing countries exhibit a growth trend, as it is possible to see in next figures 6.7 and 6.8.

Figure 6.7: Recent evolution on PPP flows* by sector



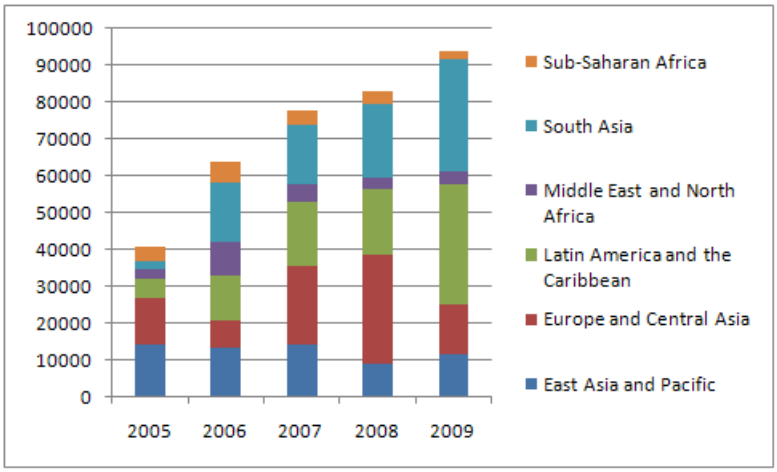
* in current US$ millions

Source: Based on PPI Database

Among sectors, only energy had investment growth for all project sizes, thanks to the activity in new power plants. Transport continues to be the sector most affected by the crisis. According to Izaguirre (2010), transport had the largest share of projects delayed, canceled, or at risk of delay by the end of 2009. This is not surprising given the decline in global demand for transport, which is a sector particularly correlated with economic activity, which slowed in 2009.

It should be emphasized that these investment levels are attributed to just a few economies. Large projects developed in emerging countries like India and China, have boosted the totals, the vast majority of developing countries remains affected by the crisis. If large projects (US$ 1 billion or more) were excluded, almost all developing regions would have seen investment decline in 2009. Europe and Central Asia is the most affected region. South Asia was the exception, thanks to the strong activity in India. Latin America was also an exception. There is also evidence that new projects continue to be postponed and canceled because of the financial crisis.

Figure 6.8: Recent evolution on PPP flows* by region



* in current US$ millions

Source: Based on PPI Database

In the same line of what was mentioned in Section 3.6, concerning the prospects for infrastructure finance, the World Bank in its "*September 2010 - PPI data update note 38*" (World Bank, 2010) presents more details about the recent trends on infrastructure PPP. A summary is presented below:

- Investment in new projects fell in the first quarter of 2010, but remained strong and selective. In the first quarter of 2010, 53 projects with investment commitments of US$22.6

billion reached financial or contractual closure in 21 developing countries. While this investment represents a 25% drop from the level reported in the first quarter of 2009, it is the second highest of any first quarter since 1995;

- Investment growth in projects continues to be concentrated in the largest developing economies, particularly India, which accounted for more than half of investment in the first quarter of 2010. Three other large economies (Brazil, China, and Turkey) saw lower investment in this quarter than in the same quarter of 2009. The remaining developing countries saw some investment growth, however, it is too soon to assess whether this recovery will continue and reverse the trend of declining investment in these countries;

- Large projects account for most of the investment in new projects - investment is concentrated in projects of US$1 billion or more. As a conclusion, the average project size grew from US$146 million in 2004 to US$457 million in the first quarter of 2010;

- Liquidity and other financial market conditions have improved, but they remain more stringent than before the global financial crisis. While infrastructure projects are raising financing, they continue to face financial markets with reduced liquidity and tougher conditions (lower debt/equity ratios, shorter tenors, and more conservative structures). Greater project selectivity is also expected to continue;

- As a consequence, local State-owned banks and multilateral agencies continue to be key financiers. Given the lack of liquidity from commercial banks that would normally take part in loan syndications, this growing participation by local public banks and multilateral financing institutions is not surprising. Nevertheless, these institutions are unlikely to have the capacity to fully replace commercial sources of financing;

- The impact of the financial crisis on project delay or cancellation has diminished. By the end of the first quarter of 2010, projects representing 9% of total investment had, due to the crisis, been delayed (6%) or canceled (2%) or were at risk of being delayed (1%) if financing was not arranged in the coming months;

- Greenfield projects continue to be best able to raise debt. Within the greenfield category, energy projects, particularly power plants, have raised the most debt since 2008. Concessions, by contrast, have not been able to raise much financing. Many reached contractual closure (with the concession contract being signed and the private operator taking over the assets) with the agreement that funding would be raised later. But many of the concessions, reaching contractual closure in 2008 and 2009, experienced delays in securing required financing;

- Despite the more difficult environment, developing country governments remain committed to their PPP programs - by the first quarter of 2010, 61 developing countries had around 440 projects that were seeking financing, had been awarded and had yet to start looking for finance, or were in the final tender stage. Those projects involve investment commitments of US$174 billion.

Developing countries risks, assessed in several dimensions (political, legal, economic, financial, social), are critical to measure the attractiveness of a country to private agents and international institutions. Such evaluation by these agents affect the development of partnerships with governments and the implementation of infrastructure projects. In Section 6.3 this issue is detailed, as the main framework for the empirical analysis that follows.

6.3 Conceptual framework and hypothesis development

A fundamental prerequisite for PPP is private sector involvement. But is important to ascertain, what factors determine the degree of such involvement, and moreover, which country risk is the more influential, affecting such involvement.

Moreover, risks are enhanced for infrastructure PPP developed in emerging countries and the involvement of MDB plays an important "enabling" function acting like a mechanism of risk reduction. Essentially, the involvement of multilateral organizations (financial institutions and export credit agencies) provides a third-party guarantee, increasing the creditworthiness of the arrangement. Therefore, in addition to the primary lending function, MDB also have a catalyzing function of private funds, which assumes particular relevance in times of financial distress. At this purpose, it is also relevant to determine what country factors are more important in explaining the MDB participation in a project.

In the empirical analysis that follows, the question how the political, legal, social, economic and financial environment in host countries influence risk perceptions and hence, the participation of the private sector and of MDB in infrastructure PPP, is answered. In addition, the effect of the same risk factors on the number and value of PPP projects is also explored.

Political Risk

We expect to find a clear relationship between the participation of private sector and MDB in PPP arrangements and the political risk of a country. More precisely, private sector prefers to invest in politically stable countries and MDB should participated in PPP more frequently for projects developed in countries characterized by high political risk - the higher the political risk of a country, the higher the probability of a PPP to be structured with MDB participation and inversely, the lower the degree of private sector involvement.

Hypothesis 1 - The probability of having a PPP with a MDB participation is positively related to the level of political risk.

Hypothesis 2 - The degree of private sector participation in a PPP is negatively related to the level of political risk.

As proxies for the level of political risk that may affect infrastructure investments, we use measures of the democratic regime (related to the access to government offices: elections and their competitiveness) and of democratic governance, meaning the process whereby government make and implement legally binding decisions, all drawn from Beck et al. (2000). Political risk is higher for countries where governments do not exhibit political checks and balances[3] or that restrains electoral competition. Therefore, the variables used are:

- Index of Political Competitiveness, a variable that characterize the competitiveness of elections. It measures the number of parties competing in elections and range from 1 (low) to 7 (high competitiveness). More political competitiveness leads to a reduction of the political risk of a country, with more transparent and accountable governments, which are pre-requisites for PPP to be successful.
- Checks - The quality of governance affects a country's ability to benefit from international capital flows. A key element in the description of any political system is the number of decision makers whose agreement is necessary before policies can be changed and it is generally accepted that countries with multiple decision makers may offer greater protection to investors from arbitrary government actions - as measure of government accountability

[3]Checks and Balances is a system of distribution of powers among the executive, legislative and judicial branches of government, used to balance the powers and prevent one branch to obtain power in excess (http://law.yourdictionary.com/checks-and-balances, accessed on January 10, 2011).

the variable *checks* is used. This variable assumes the value 1, for countries where legislatures are not competitively elected (only the executive wields a check), and increase with the number of veto players in the system.

- Political System - An additional measure of the relationship of the executive and legislative branches. Countries are classified as direct presidential (0), strong president elected by assembly (1) or parliamentary (2).

Legal Risk

A PPP is, in essence, a bundle of contracts - financial and non-financial contracts. Typically these contracts are naturally incomplete and prone to opportunistic behaviour. Therefore, private investors must ensure they have legal rights and that the local law enforcement is efficient. It is expected that countries with strong legal protection will be able to raise more long-term private capital to develop infrastructure projects and the participation of MDB with its effect of "umbrella" will be less important for these countries, thus:

Hypothesis 3 - The probability of having a PPP with MDB participation is positively related to the level of legal risk.

Hypothesis 4 - The degree of private sector participation in a PPP is negatively related to the level of legal risk.

As proxies for the level of legal development, the next variables are used:[4]

- Creditor rights index - We measure the creditor rights in the country in which the project is located based on LaPorta et al. (1998) index and expanded by Djankov et al. (2007). The authors show that legal creditor rights are an important determinant of private credit development. The creditor rights index varies between 0 (poor creditor rights) and 4 (strong creditor rights).
- Contract enforcement days - The number of calendar days to resolve a payment dispute through courts, also from Djankov et al. (2007). LaPorta et al. (1998) emphasizes the importance of legal enforcement as well the quality of the laws on the books (measured by the creditor rights index). Both measures of the quality of the legal system matters and provide a complementary analysis (laws on the books and its applicability).

[4]Similarly to previous empirical studies of Esty and Megginson (2003), Gatti et al. (2008) or Subramanian et al. (2008), testing legal variables.

- Legal origin - A dummy variable that identifies a country's legal origin. This variable was first proposed by LaPorta et al. (1998) with four possibilities - English, French, German and Nordic - and was expanded by Djankov et al. (2007), adding a fifth category - Socialist (transition).[5] A link between the origin of a country's legal tradition and the operation of its financial system was first established by LaPorta et al. (1998). The authors have found that countries with common law legal institutions provide better protection to creditors than do countries with civil law institutions. More recently, reinforcing this idea, Beck et al. (2004) empirically demonstrate that countries with civil law provide creditors with weaker legal rights and, as a consequence, firms face higher obstacles in contracting for external finance than firms in other countries.

Economic and Financial Risks

The macroeconomic environment can also affect project' risks and the participation of private sector and MDB in PPP, thus:

Hypothesis 5 - The probability of having a PPP with MDB participation is positively related to the level of economic and financial risks.

Hypothesis 6 - The degree of private sector participation in a PPP is lower for countries with higher economic and financial risks.

In general, economic and financial risks assessments improve for countries with larger economic size (GDP), lower inflation, low external debt and more developed financial markets. Each determinant of economic and financial development derives from the theoretical literature, for instance, Altunbas and Gadanecz (2003), Cantor and Packer (1996) or Eichengreen and Mody (2000), found that the following macroeconomic fundamentals are important as explanatory variables of the capital flows to emerging markets:

- Real GDP per capita and economic growth, used to measure the evolution of the country's wealth.

[5]The English legal origin includes the common law of England, and the former colonies, U.S., Australia and Canada. The French legal origin includes the civil law of France and also, countries Napoleon conquered (including Portugal and Spain) and former colonies. The German legal origin includes the laws of the Germanic countries in Central Europe, but also countries in East Asia. The Nordic legal origin - laws of the four Scandinavian countries. And the Socialist legal origin - for the new countries that emerged from the breakup of the Soviet Union, plus Mongolia. The Socialist category does not apply to countries that have gone back to their pre-communist legal systems, where they were assigned to their pre-war legal systems (Djankov et al., 2007).

- Inflation rate and international reserves. As Cantor and Packer (1996) argue, a high rate of inflation points to structural problems in the government's finances and is a focus of instability. Therefore a controlled inflation and the existence of significative international reserves are indicators of a country macroeconomic stability.

- External debt and general government balance. It is expected that governments with large deficits and high debt burden will be more interested in PPP to solve infrastructure problems. But at the same time, these two variables are a focus of economic instability increasing the risk level of a country. A higher debt burden imply a higher risk of default and the weight of the burden increases as a country's external debt rises relative to its foreign currency earnings (exports of goods and services). In addition, governments with large and structural deficits increase foreign indebtedness, which may become unsustainable over time.

- Fuel exports as a measure of a country's natural resources. As mentioned in Rose-Ackerman and Tobin (2005), the existence of natural resources is expected to attract much more investment regardless of other relevant factors, and this is also true for infrastructure projects.

- Population. An additional factor that should be accounted for is the dimension of the market. Concerning PPP, it is an important feature of the attractiveness of a project to the private sector, specifically, if projects are to be financed also with user charges. Therefore, PPP tend to be more common in larger markets.

Linking infrastructure development more effectively with private finance markets helps to leverage and mobilize more capital. By contrast, underdeveloped financial markets makes the private participation in infrastructure projects relatively more difficult, particularly, as reported by Izaguirre (2010), when domestic investors are becoming more prominent as a major source of funds to infrastructure projects. In addition and as mentioned by Delmon (2007), the provision of new risk mitigation instruments by MDB and the deepening of local capital markets also contribute to the sustainability of PPP. There is no single measure of financial development, but we use the following, most commonly used and drawn from Beck et al. (2009):[6]

- Liquid liabilities of the financial system to GDP - is a traditional measure of financial depth and measure the size of the financial intermediary sector relative the size of the economy. This indicator shows the degree to which the financial sector mobilizes domestic savings - larger depth should reflect greater financial development.

[6]See, for instance, Esty (2003b).

- Financial claims on the private sector by deposit money banks and other financial institutions divided by gross domestic product (GDP) - countries with higher private credit to GDP, usually have higher rates of economic growth;
- And finally, the ratio of deposit money bank assets to the sum of deposit money and central bank assets. This is a measure of the relative importance of commercial *versus* central banks. It has been shown that countries where commercial banks have a higher role in financial intermediation (rather than central banks) also face a higher degree of financial development.

Social Risks

As a final dimension to be assessed in its importance for PPP projects, measures of human development are included, that we roughly call "social factors". It is expected that proxies for human development should have an effect in infrastructure projects, particularly in explaining MDB participation, given their mission as development agencies, although that effect should not be so clear concerning private sector participation. Nevertheless, some empirical studies have showed that civil freedom may encourage foreign direct investment (see Harms and Ursprung, 2002).

Hypothesis 7 - The probability of having a PPP with MDB participation is higher for countries with higher respect for human rights and civil liberties.

Hypothesis 8 - The degree of private participation in a PPP is higher for countries with higher respect for human rights and civil liberties.

Besides the traditional measure of per capita income, as a proxy of well-being and economic development (already included in the economic variables), two proxies for human rights and social development are drawn from the "Cingranelli-Richards (CIRI) Human Rights Dataset" and an additional measure of civil liberties, from the survey "Freedom in the world":

- Empowerment Rights Index - This is an additive index constructed from the Freedom of Movement, Freedom of Speech, Workers' Rights, Political Participation and Freedom of Religion indicators. It ranges from 0 (no government respect for these five rights) to 10 (full government respect for these five rights).

- Physical Integrity Rights Index - This is an additive index constructed from the Torture, Extrajudicial Killing, Political Imprisonment and Disappearance indicators. It ranges from 0 (no government respect for these four rights) to 8 (full government respect for these four rights).
- Civil liberties are measured on a one-to-seven scale, with one representing the highest degree of freedom and seven the lowest.

In addition, to ascertain whether sectoral and regional differences have an effect on the agents' participation on PPP projects, we consider the next dummies:

- Dummies for regions - East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, Middle East and North Africa (the reference sector), South Asia and Sub-Saharan Africa;
- Dummies for sectors - energy, telecommunications, transport and water/ sewerage as the base sector.

Finally, time dummies are included in all regressions to capture potential time-specific effects.

For simplicity reasons, the previous hypotheses development do not include the reference to the number and value of PPP projects, but:

- all the hypotheses concerning the probability of MDB participation should be extended to include, the *number of projects with MDB participation* and *the amount of financial support provided* by those agencies, which can be considered additional measures of MDB involvement. In general the higher the risk, the higher the probability of a MDB participate in PPP and therefore, the higher the number of projects with MDB participation and the financial support provided, with the exception of the social risk dimension. In this risk dimension, we expect that countries that respect more human rights will benefit with more involvement of MDB, meaning lower social risk associated with higher involvement.

- all the hypotheses developed concerning the degree of private sector participation should be extended to include the *total number of PPP projects* and the *investment value of PPP projects*, that are inversely related to the overall level of a country risk, expressed in the different dimensions (political, legal, social, economic and financial).

As a summary from the previous exposition, Table 6.1 highlights the empirical study that follows and the structure used in the next sections, concerning the methodology and the discussion of the results. More details on the variables are presented in Section 6.5.

Table 6.1: Regressions summary

Dependent variable		**Explanatory variables**	**Unit of observation**	**Number of observations**
Type	**Description**			
Fractional variable $0 \leq y \leq 1$	Degree of private sector participation in a PPP project	• Proxies for political, legal, economic, financial and social risks • MDB dummy • Sector dummies • Time dummies	The PPP project	2095
Binary variable $y = 0$ or $y = 1$	$y = 1$ if the MDB participate in the PPP project, $y = 0$ otherwise	• Proxies for political, legal, economic, financial and social risks • Sector dummies • Time dummies	The PPP project	2095
Count variable $y = 0, 1, 2 \cdots$ (discrete values)	Number of PPP projects in a country for a given year	• Proxies for political, legal, economic, financial and social risks • Time dummies	Country/year	481
Count variable $y = 0, 1, 2 \cdots$ (discrete values)	Number of PPP projects with MDB participation in a country for a given year	• Proxies for political, legal, economic, financial and social risks • Time dummies	Country/year	481
Continuous and nonnegative variable $y \geq 0$	Real dollar value of PPP investments in a country for a given year	• Proxies for political, legal, economic, financial and social risks • Time dummies	Country/year	732
Continuous and nonnegative variable $y \geq 0$	Real dollar value of MDB financial support to PPP in a country for a given year	• Proxies for political, legal, economic, financial and social risks • Time dummies	Country/year	732

Next section presents the appropriate econometric models given the nature of the variables under study, and some methodological issues are explored.

6.4 Methodology

The models used in all regressions are *limited dependent variable models*, given the particular characteristics of the dependent variable.[7] The estimation method is, in general, Maximum Likelihood Estimation (MLE) for all the models, and exceptionally when appropriate, Ordinary Least Squares (OLS).

6.4.1 Binary and Fractional variables

First, when the problem consists of describing the *probability of the participation of a MDB in a PPP*, where we have only two alternatives, a binary choice model should be used. The dependent variable is,

$$y = \begin{cases} 1 & \text{with probability } p \\ 0 & \text{with probability } 1-p \end{cases} \tag{6.1}$$

The simplest alternative is to use the Linear Probability Model (LPM) with OLS regression, but it has some drawbacks namely, the possibility of the predicted probabilities exceed one or to be less than zero and the assumption that the partial effect of any explanatory variable is constant. Moreover, the LPM will, by definition, produce heteroscedasticity in the error term, although this is by far a less important drawback than the others mentioned before, because variances can be estimated consistently. Nevertheless, the LPM may be used as a starting point and as an exploratory tool.

More proper models are the Probit and Logit that belong to the class of binary response models. The choice of one of these models will guarantee that the predicted values will be in the 0–1 interval. Either the Probit or the Logit are binary response models of the form,

$$P(y = 1|\mathbf{x}) = G(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k) \tag{6.2}$$

where $\mathbf{x} = (x_1, x_2, \ldots, x_k)$ and $G(.)$ is a function taking on values strictly between zero and one, $0 < G(z) < 1$, for all real numbers z. In the Probit model, $G(.)$ is the standard normal cumulative distribution function (cdf), which is expressed as the integral,

[7] This section is based on Cameron and Trivedi (2005), Wooldridge (2002) and Wooldridge (2003).

$$G(z) = \Phi(z) \equiv \int_{-\infty}^{z} \phi(v)dv \tag{6.3}$$

where $\phi(z)$ is the standard normal density,

$$\phi(z) = (2\pi)^{-1/2} exp(-z^2/2) \tag{6.4}$$

An alternative choice could be the logistic distribution function and therefore,

$$G(z) = exp(z)/[1 + exp(z)] = \Lambda(z) \tag{6.5}$$

In order to estimate the parameters, a likelihood function is maximized. The coefficients β_j for $j = 1, 2, \ldots, k$, give the signs of the partial effects of each x_j on the response probability, but not their magnitude. Therefore, the interpretation of their value is not as straightforward as in the LPM.

For the purpose of study the probability of having a PPP with MDB participation, depending on the proxies for different risks, we use the three methods mentioned above, although the LPM only as an exploratory tool, given its limitations. If we have to choose between Logit and Probit models, it is important to note that both distributions are similar except for the tails. Therefore, for intermediate values of $x'\beta$ the probabilities of both distributions are similar. Nevertheless, as measures of goodness of fit of the models, we should look to the maximum value of the likelihood function that indicates the best model to choose or compare the $pseudo - R^2$ of the models. It is also possible to do the evaluation by comparing the fitted and actual values using the $pseudo - R^2$ and the percentage of observations correctly classified. High values of these measures indicate a good fit of the model.

Second, the dependent y, the *degree of private participation* is a fractional response variable, ranging from 0–1. We use the generalized linear models (GLM) approach, first proposed by Papke and Wooldridge (1996), with robust standard errors. Several functional forms for the conditional mean of y that enforce the conceptual requirement that $E(y|\mathbf{x})$ is in the unit interval, may be used. We have,

$$E(y|\mathbf{x}) = G(z) \tag{6.6}$$

where $G(.)$ is a known nonlinear function satisfying $0 < G(.) < 1$. Recently Ramalho et al. (2011), compare different models, estimators and specification tests, to deal with fractional response variables. Particularly in this work, alternative nonlinear conditional mean specifications are tested: Logit, Probit, Loglog, Complementary Loglog (Cloglog) and Cauchy. In addition, the authors discuss the option between one-part models and two-part models, this last option is more appropriate for situations where the number of observations at one or both boundaries occur with too large frequency, justifying the rationale for two different mechanisms.

In this work, the observed values verify $0 < y \leq 1$, with a large proportion of observations with $y = 1$. Therefore, we consider appropriate to use one model to explain the binary variable $y^* = 1$ if $y = 1$ and $y^* = 0$ if $0 < y < 1$, while another model will be used to explain the fractional $0 < y < 1$.

As mentioned in Ramalho et al. (2011), while the logistic and standard normal specifications for $G(.)$ are symmetric about the point 0.5 and consequently approach 0 and 1 at the same rate, the Complementary Loglog model is not symmetric and increases sharply when $G(.)$ is near 1, making this last model the more appropriate to fit our data, as we will discuss in Section 6.6.1. The extreme minimum distribution function underlying the Complementary Loglog model is given by,

$$G(z) = 1 - exp(-exp(z)) \tag{6.7}$$

Because estimates from the different models proposed for binary and fractional variables are not directly comparable, interest lies in the estimation of marginal effects. The marginal effects differ with the point of evaluation $\mathbf{x}$ and differ with different choices of $G(.)$, for the Logit specification the marginal effect for continuous variables is given by,

$$\frac{\partial E(y|\mathbf{x})}{\partial x_j} = \Lambda(\beta_0 + \mathbf{x}'\boldsymbol{\beta})[1 - \Lambda(\beta_0 + \mathbf{x}'\boldsymbol{\beta})]\beta_j \tag{6.8}$$

while for the Probit specification is,

$$\frac{\partial E(y|\mathbf{x})}{\partial x_j} = \phi(\beta_0 + \mathbf{x}'\boldsymbol{\beta})\beta_j \tag{6.9}$$

and for the Complementary Loglog is,

$$\frac{\partial E(y|\mathbf{x})}{\partial x_j} = exp(-exp(\beta_0 + \mathbf{x}'\boldsymbol{\beta}))exp(\beta_0 + \mathbf{x}'\boldsymbol{\beta})\beta_j \tag{6.10}$$

In respect to dummy variables, a finite-difference method is used computing the marginal effect by comparing the conditional mean with and without that dummy variable equal to one. The discrete effect of a dummy variable is found by taking the difference in the predicted probability, as follows,

$$\frac{\Delta E(y|\mathbf{x})}{\Delta x_j} = E[y|d=1] - E[y|d=0] \tag{6.11}$$

In this work, we use AME - average marginal effects, that show the average response of all individuals. The marginal effect is obtained for each observation and next, the sample average of individual marginal effects is computed to obtain the overall marginal effect. As mentioned in Ramalho et al. (2011), the estimation of average sample effects (AME) seems to be much more robust to misspecification of the functional form, especially when Logit and Probit models are employed.

6.4.2 Count variables

The number of PPP arrangements per country and year is used, considering on one hand, all the projects and on the other hand, just projects with MDB participation - in both situations, we have count variables that only take nonnegative integer values.

To model these variables, the first natural choice is to use the Poisson regression model. The Poisson distribution is a discrete probability distribution that expresses the probability for the number of occurrences of the event, with a probability mass function,

$$Pr[Y=y] = \frac{e^{-\mu}\mu^y}{y!}, \qquad y = 0, 1, 2, \ldots \tag{6.12}$$

where μ is the intensity or rate parameter and it can be shown that $E[Y] = \mu$ and $var[Y] = \mu$. A regression model specifies the parameter μ to vary across individuals according to a specific function of regressor vector $\mathbf{x}$ and parameter vector $\boldsymbol{\beta}$. The usual Poisson specification is $\mu = exp(\mathbf{x}'\boldsymbol{\beta})$, which has the advantage of ensuring that the mean $\mu > 0$. The density of the Poisson regression model is therefore,

$$f(y|\mathbf{x}, \boldsymbol{\beta}) = e^{-exp(\beta_0 + \mathbf{x}'\boldsymbol{\beta})} exp(\beta_0 + \mathbf{x}'\boldsymbol{\beta})^y / y! \tag{6.13}$$

In practical applications, the Poisson regression model is considered usually too restrictive. The Poisson key assumption of "mean equal to variance", called the equidispersion property, is often violated. Typically, for count data the variance exceeds the mean (overdispersion) and as such, it is necessary to use alternative models. For instance, Negative Binomial models lead to better results.

The Negative Binomial model is an example of a continuous mixture model. Consider the distribution of a random count y that is Poisson, conditional on the parameter λ, so that $f(y|\lambda) = exp(-\lambda)\lambda^y/y!$. Suppose that the parameter λ is random, rather than being a completely deterministic function of regressors $\mathbf{x}$. In particular, let $\lambda = \mu v$, where μ is a deterministic function of $\mathbf{x}$, for example $exp(\mathbf{x}'\boldsymbol{\beta})$ and $v > 0$ is independent and identically distributed (iid) with density $g(v|\alpha)$. The marginal density of y, unconditional on the random parameter v but conditional on the deterministic parameters μ and α, is obtained by integrating out v. This gives,

$$h(y|\mu, \alpha) = \int f(y|\mu, v)g(v|\alpha)dv, \tag{6.14}$$

where $g(v|\alpha)$ is called the mixing distribution and α denotes the unknown parameter of the mixing distribution. The integration defines an "average" distribution. For some specific choices of $f(.)$ and $g(.)$, the integral will have an explicit or closed-form solution. Considering that $f(y|\lambda)$ is the Poisson density and $g(v)$ is the gamma density, $g(v) = v^{\delta-1}e^{-v\delta}\delta^\delta/\Gamma(\delta)$, with $\delta, v > 0$, the negative binomial as a mixture density is given by,

$$h(y|\mu, \delta) = \int_0^\infty \frac{e^{-\mu v}(\mu v)^y}{y!}\frac{v^{\delta-1}e^{-v\delta}\delta^\delta}{\Gamma(\delta)}dv, \tag{6.15}$$

and after some simplifications, follows,

$$h(y|\mu, \delta) = \frac{\Gamma(\alpha^{-1} + y)}{\Gamma(\alpha^{-1})\Gamma(y + 1)}\left(\frac{\alpha^{-1}}{\alpha^{-1} + \mu}\right)^{\alpha^{-1}}\left(\frac{\mu}{\mu + \alpha^{-1}}\right)^y, \tag{6.16}$$

where $\alpha = 1/\delta$ and $\Gamma(.)$ denotes the gamma integral which specializes to a factorial for an integer argument. The first two moments of the negative binomial distribution are,

$$E[y|\mu, \alpha] = \mu, \tag{6.17}$$

$$var[y|\mu, \alpha] = \mu(1 + \alpha\mu). \tag{6.18}$$

The variance exceeds the mean, since $\alpha > 0$ and $\mu > 0$. As mentioned in Cameron and Trivedi (2005), Negative Binomial models can be very useful in applied work, with the necessary flexibility to provide a good fit to many types of count data.

In this empirical work, when the dependent variable is the *total number of PPP projects per country and year*, the minimum value recorded is one. In this situation the standard Poisson and Negative Binomial models are not proper choices, because the estimation procedures will try to fit the models by including probabilities for zero values. One possibility is to use Zero Truncated Models that allow a more accurate fit by using a probability model that does not include the zero values. It is possible to consider our data as an example of *truncation*, because information is only available for countries that register the number of PPP projects. The data are truncated from below at zero and we only observe $y = y^*$ if $y > 0$.[8]

Truncation leads to inconsistent parameter estimates unless the likelihood function is properly modified. For the situation of zero truncation, let $f(y|\boldsymbol{\theta})$ denote the density function and $F(y|\boldsymbol{\theta}) = Pr[Y \leq y]$ denote the cumulative distribution function of the discrete random variable, where $\boldsymbol{\theta}$ is a parameter vector. If realizations of y less than the positive integer 1 are omitted, the ensuing zero-truncated density is given by,

$$f(y|\boldsymbol{\theta}, y \geq 1) = \frac{f(y|\boldsymbol{\theta})}{1 - F(0|\boldsymbol{\theta})}, \qquad y = 1, 2, \ldots \tag{6.19}$$

If we consider $f(y|\mu, y \geq 1) = e^{-\mu}\mu^y/[y!(1 - exp(-\mu))]$, then we have a Zero-Truncated Poisson model. Particularly in what concerns our data, as some evidence of overdispersion appear, Zero Truncated Negative Binomial models seem to be a better option.

A different problem that may arise with count data is the excess zeros problem, i.e., the presence of more zeros in the data than predicted by count models such as Poisson or Negative Binomial models. To deal with this situation, two approaches may be followed.

[8] Cameron and Trivedi (2005) provide an additional example with the number of visits to a health clinic, where data are only available for people who visited the health clinic.

The first is to use a Two-Part model, separating the zeros from the positives counts and therefore using two different models, a binary choice model to explain the zero *vs* the nonzero values and a zero-truncated model for the second part (two-part models are further detailed in next section).

The second approach is to use a modified count model called zero-inflated model. This supplements a count density $f_2(.)$ with a binary process with density $f_1(.)$. If the binary process takes value 0, with probability $f_1(0)$, then $y = 0$. If the binary process takes value 1, with probability $f_1(1)$, then y takes count values $0, 1, 2, \cdots$ from the count density $f_2(.)$. This lets zero counts occur in two ways: as a realization of the binary process and as a realization of the count process when the binary random variable takes value 1, differing this way from a Two-Part model. The density is,

$$g(y) = \begin{cases} f_1(0) + (1 - f_1(0))f_2(0) & \text{if } y = 0 \\ (1 - f_1(0))f_2(y) & \text{if } y \geq 1 \end{cases} \tag{6.20}$$

where $f_1(.)$ is a Logit model and $f_2(.)$ is a Poisson or Negative Binomial density. In econometrics, this model is much less used than the Two-Part model, although it is capable of modeling data with few zeros.

Another possibility is to use Ordered Response models, modelling the count variable as multinomial data. Ordered multinomial models are a generalization of binary choice models. There are several possible outcomes (mutually exclusive) and the alternatives follow a natural order. The underlying relationship to be characterized is,

$$y^* = \mathbf{x}'\boldsymbol{\beta} + u \tag{6.21}$$

where y^* is a latent (unobservable) variable. There are m alternatives and the dependent variable y is defined to take the value j if the jth alternative is taken, $j = 0, 1, \ldots, m$.

For a m-alternative ordered model, the categories of response can be observed as,

$$y = j \qquad if \qquad \alpha_{j-1} < y^* \leq \alpha_j, \tag{6.22}$$

with $\alpha_0 = -\infty$ and $\alpha_m = \infty$. Different values of α are the increasing and unknown thresholds, which are also parameters to be estimated. And then,

$$\begin{aligned} Pr[y=j] &= Pr[\alpha_{j-1} < y^* \leq \alpha_j] \\ &= Pr[\alpha_{j-1} < \mathbf{x}'\boldsymbol{\beta} + u \leq \alpha_j] \\ &= Pr[\alpha_{j-1} - \mathbf{x}'\boldsymbol{\beta} < u \leq \alpha_j - \mathbf{x}'\boldsymbol{\beta}] \\ &= G(\alpha_j - \mathbf{x}'\boldsymbol{\beta}) - G(\alpha_{j-1} - \mathbf{x}'\boldsymbol{\beta}) \end{aligned} \tag{6.23}$$

If u is standard normal distributed, then $G(.)$ is the standard normal cdf and we have an Ordered Probit Model. While for the Ordered Logit Model, u is logistic distributed and $G(.)$ is the logistic distribution. The sign of the parameters $\boldsymbol{\beta}$ can be immediately interpreted as determining whether or not the latent variable y^* increases with the regressor.

For multinomial data the interpretation of the results should be made with particular care. The marginal effect is not measured as usually, as the impact on a single conditional mean of the change in a regressor, instead there is a separate marginal effect on the probability of each outcome, and these marginal effects sum to zero since probabilities sum to one. To obtain the marginal effects in the probabilities,

$$\frac{\partial Pr[y=j])}{\partial x_j} = [G'(\alpha_{j-1} - \mathbf{x}'\boldsymbol{\beta}) - G'(\alpha_j - \mathbf{x}'\boldsymbol{\beta})]\beta_j, \tag{6.24}$$

where G' denotes the derivative of $G(.)$ and the term in braces can be positive or negative.

These models are widely used to count data with few categories and have the advantage that it is more informative to do the analysis directly in terms of the probabilities of the different outcomes, instead of using a standard regression framework.

6.4.3 Nonnegative continuous variables

When the dependent variable is the *real dollar value of the investments* in infrastructure projects (per country and year) and the *real amount of support provided by MDB* for these same countries/years, the response variables are nonnegative, partly continuous and assume the value zero with positive probability.

In this situation, it is appropriate to use "corner solution models", if we consider that the zero outcome is the result of a maximization process, or otherwise, to use "two-part models" or "sample selection models", if we assume that the decision to invest is a completely different

process from the mechanism explaining the levels of investment. A critical factor influencing the choice of the model is the interpretation placed upon the observed zeros.[9]

Tobit is usually the starting point. The standard Tobit model has a censoring value at zero, and the latent variable is linear in regressors with an additive error term, normally distributed and homoscedastic. Thus,

$$y^* = \beta_0 + \mathbf{x}'\boldsymbol{\beta} + \epsilon, \qquad where \qquad \epsilon|\mathbf{x} \sim Normal(0, \sigma^2) \tag{6.25}$$

The observed y is defined,

$$y = \begin{cases} y^* & \text{if } y^* > 0 \\ 0 & \text{if } y^* \leq 0, \end{cases} \tag{6.26}$$

where – means that y is observed to be missing (no particular value of y is necessarily observed when $y^* \leq 0$).

Nevertheless, because the Tobit model relies on strong assumptions of normality and homoscedasticity of the error term, better results are often provided by more general models, namely, Two-Part models or using Heckman sample selection models. There are many different situations where the problem at study may be seen as a two-part decision, of first to engage in an activity and then deciding the level of the activity. If we expect independence between these two parts, a Two-Part model is the better choice. Alternatively, if the same factors that influence one part are expected to influence the other, with decisions intertwined, then the suitable model is the bivariate sample selection model.

A Two-Part model is appealing because it is possible to explain y with two different mechanisms: a Probit or a Logit model to explain the probability of $y = 0$ versus $y > 0$ and a second process, to explain "how much" y using only the positive outcomes. As such, we have a model that specifies the censoring mechanism and a model for the outcome conditional on the outcome being observed.

[9]Using OLS is not a good option, because similarly to the LPM for binary responses, we may get negative predicted values for y and OLS implies constant partial effects.

If we define a binary indicator variable $d = 1$ for *participants* in the activity under study, and $d = 0$ for *non-participants*, the Two-Part model is given by,

$$f(y|\mathbf{x}) = \begin{cases} Pr[d = 0|\mathbf{x}] & \text{if } y = 0 \\ Pr[d = 1|\mathbf{x}] f(y|d = 1, \mathbf{x}) & \text{if } y > 0 \end{cases} \tag{6.27}$$

for some choice of density $f(.)$, although proper choices of $f(.)$ should ensure positive values for the *participants*, for instance, the log-normal. Usually, the same regressors appear in both parts of the model and concerning the estimation, the two parts are assumed to be independent: first, with all the observations, a binary choice model is estimated; second, using only observations with $y > 0$, the parameters of the density $f(y|d = 1, \mathbf{x})$ are estimated.

Concerning the bivariate sample selection model (or type 2 Tobit or just, Heckman sample selection model), a joint distribution for the censoring mechanism and outcome is considered. In this specification, a censoring latent variable differs from the latent variable generating the outcome of interest. The model includes a *participation equation*,

$$y_1 = \begin{cases} 1 & \text{if } y_1^* > 0 \\ 0 & \text{if } y_1^* \leq 0 \end{cases} \tag{6.28}$$

and a resultant *outcome equation*, that

$$y_2 = \begin{cases} y_2^* & \text{if } y_1^* > 0 \\ - & \text{if } y_1^* \leq 0 \end{cases} \tag{6.29}$$

In this formulation, y_2 is observed when $y_1^* > 0$, and no particular value of y_2 is necessarily observed when $y_1^* \leq 0$. For the latent variables, we have linear models with additive errors, according to,

$$\begin{aligned} y_1^* &= \beta_{01} + \mathbf{x_1}'\boldsymbol{\beta_1} + \epsilon_1 \\ y_2^* &= \beta_{02} + \mathbf{x_2}'\boldsymbol{\beta_2} + \epsilon_2 \end{aligned} \tag{6.30}$$

where $\mathbf{x_1}, \mathbf{x_2}$ are vectors of explanatory variables. And the conditional mean in the sample selectivity model is,

$$\begin{aligned} E[y_2|\mathbf{x_1}, \mathbf{x_2}, y_1^* > 0] &= E[\beta_{02} + \mathbf{x_2}'\boldsymbol{\beta_2} + \epsilon_2|\beta_{01} + \mathbf{x_1}'\boldsymbol{\beta_1} + \epsilon_1 > 0] \\ &= \beta_{02} + \mathbf{x_2}'\boldsymbol{\beta_2} + E[\epsilon_2|\epsilon_1 > -(\beta_{01} + \mathbf{x_1}'\boldsymbol{\beta_1})] \end{aligned} \tag{6.31}$$

If the errors ϵ_1 and ϵ_2 are independent in (6.31), then the last term simplifies to $E[\epsilon_2] = 0$, and OLS regression of y_2 on $\mathbf{x_2}$ will give a consistent estimate of $\boldsymbol{\beta_2}$ (assumption made in a Two-Part model). However, any correlation between the two errors means that the conditional mean is no longer $\beta_{02} + \mathbf{x_2}'\boldsymbol{\beta_2}$ and is necessary to account for selection. With the additional assumption that the correlated errors are joint normally distributed and homoscedastic, the unknown parameters can be estimated through MLE. Yet, this is still a strong assumption and an alternative estimation procedure that relies on weaker distributional assumptions is the Heckman two-step procedure or Heckit estimator. From the previous expression, when ϵ_1 and ϵ_2 are correlated and jointly normally distributed, it implies that,

$$\epsilon_2 = \sigma_{12}\epsilon_1 + \xi \tag{6.32}$$

where ξ is independent from ϵ_1. After some simplifications, the conditional mean becomes,

$$E[y_2|\mathbf{x_1}, \mathbf{x_2}, y_1^* > 0] = \beta_{02} + \mathbf{x_2}'\boldsymbol{\beta_2} + \sigma_{12}\lambda(\beta_{01} + \mathbf{x_1}'\boldsymbol{\beta_1}), \tag{6.33}$$

where $\lambda(z) = \phi(z)/\Phi(z)$, is the inverse Mills ratio. Heckman assumes (6.33) without explicitly imposing the normal distribution for the error term and noting that (6.33) is a linear function of the parameters $(\beta_{02}, \boldsymbol{\beta_2}, \sigma_{12})$ that can be estimated by OLS, if the response $\lambda(.)$ is observed. However, this is not the case, because $\lambda(.)$ depends on the unknown parameters $(\beta_{01}, \boldsymbol{\beta_1})$. Therefore the author proposes a two-step procedure which allows $\widehat{\boldsymbol{\beta}}_{\mathbf{1}}$ to be obtained by a first-step Probit regression of y_1 on $\mathbf{x_1}$. The second step is to estimate the following model by OLS, using the positive values of y_2,

$$y_2 = \beta_{02} + \mathbf{x_2}'\boldsymbol{\beta_2} + \sigma_{12}\lambda(\beta_{01} + \mathbf{x_1}'\widehat{\boldsymbol{\beta}}_{\mathbf{1}}) + v \tag{6.34}$$

where v is an error term and $\lambda(\beta_{01} + \mathbf{x_1}'\widehat{\boldsymbol{\beta}}_{\mathbf{1}}) = \phi(\beta_{01} + \mathbf{x_1}'\widehat{\boldsymbol{\beta}}_{\mathbf{1}})/\Phi(\beta_{01} + \mathbf{x_1}'\widehat{\boldsymbol{\beta}}_{\mathbf{1}})$ is the estimated inverse Mills ratio. Testing for correlation between the errors is to test if $\sigma_{12} = 0$ and in the presence of correlation, sample selection correction is needed.

This is a more general framework, because the error terms do not need to follow a normal distribution. The main advantages of this model include its simplicity, the wider applicability and the fact that requires weaker distributional assumptions than using MLE. Nevertheless,

Heckman's two-step procedure faces two different complications. First, because it is a two-step method, variances need to be corrected and second, identification problems may arise, because exactly the same regressors are used, $\mathbf{x_1} = \mathbf{x_2}$, and the observation that the inverse Mills ratio term $\lambda(.)$, is approximately linear over a wide range of its argument, leads to multicollinearity problems. The first problem is automatically solved by STATA and concerning the second, a multicollinearity diagnostic should be performed.

Next section details our data and variables. In addition, the summary statistics are shown, as well as the expected effect of the independent variables on y.

6.5 Data and Variables

In this study the dependent variables were constructed from the PPI Project Database (World Bank), available on-line at http://ppi.worldbank.org, using projects developed in low- and middle-income countries that reached financial closure from 1990 – 2007. We collect data on 96 different countries, also classified in six regions - East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, South Asia and Sub-Saharan Africa. According to the database, infrastructure projects are classified into four sectors - energy (electricity and natural gas), telecommunications, transport (railways, airports, toll roads and seaports), and water / sewerage. In addition, projects are classified into four broad categories of private participation: management and lease contracts, concessions, greenfield projects and divestitures.

For the purpose of this work, only concessions, greenfield projects and partial divestitures are used - types of private participation that could be considered PPP, sharing the key characteristics of long term nature of the relationship, distribution of risks between the public and the private partner, bundling of different project phases and private finance.

For the explanatory variables, the first set of data pertains to the political systems, where all the indicators are drawn from Beck et al. (2000). The second set of data includes proxies for the quality and enforceability of the legal system and are computed for 129 countries by Djankov et al. (2007), expanding the former data set of LaPorta et al. (1998) only available for 49 countries. Concerning macroeconomic data, all the variables are available from the World Bank's

World Development Indicators. Proxies for a country's level of financial development are taken from Beck et al. (2009), available in the World Bank's Financial Development Database, and finally, proxies to measure the degree of social development of a country and respect for human rights are from "The Cingranelli-Richards (CIRI) Human Rights Dataset", available on-line at http://ciri.binghamton.edu/index.asp, and from the survey "Freedom in the world", available on-line at http://www.freedomhouse.org.

The explanatory variables capture several country attributes that are expected to have a significative effect on infrastructure investments through PPP, on the number of projects developed and in the participation level of the agents. The variables were chosen to minimize collinearity problems and to maximize the number of nonmissing observations. It should be noted that several other variables were tested, namely, *corruption* in the political dimension, *religion* in the social dimension, and even proxies for a "geographical dimension", but were excluded due to problems on data availability.

The independent variables are:

- Political System - presidential(0), assembly-elected presidential (1) or parliamentary (2);
- Index of Political Competitiveness, which varies from 1 (low) to 7 (high competitiveness);
- Checks - number of governmental checks and balances, which varies from 1 to 18;
- Creditor rights - An aggregate index, which varies from the value 0 for weak creditor rights to 4, meaning strong creditor rights;
- Contract enforcement days - the number of days to resolve a payment dispute through courts, presented in logs and levels;
- Legal origin - English, French, German and Socialist. Three dummies are used, being the French civil law the reference;
- Physical Integrity Rights Index, it ranges from 0 (no government respect) to 8 (full government respect);
- Empowerment Rights Index, it ranges from 0 (no government respect) to 10 (full government respect);
- Civil liberties, which varies from 1 (highest degree of freedom) to 7 (the lowest);
- Deposit money bank assets, divided by the sum of deposit money and central bank assets;
- Liquid liabilities to GDP;
- Private Credit to GDP;
- General government balance (percent of GDP);
- External debt (percent of total exports);
- Economic growth - GDP growth (annual %);
- Fuel exports (% of merchandise exports);
- Real GDP per capita - constant 2000 US$, presented in logs and levels;
- Inflation Rate (annual percent change, GDP deflator);
- Population, total, presented in logs and levels;
- Reserves (in months of imports).
- MDB dummy - a binary variable that takes the value 1 if the PPP project has a MDB participation and takes the value 0, otherwise. Only considered for the regression on the degree of private participation.

Table 6.2 includes information about which variables are associated with each of the risks considered and their expected effect on the dependent variable.

Table 6.2: Expected effect of the explanatory variables on y

Explanatory variables	Effect on a country risk level	Dependent variable: Probability of a PPP with a MDB participation (1)	Dependent variable: Degree of private participation (2)
Political Risk			
Political System	-	-	+
Index of Political Competitiveness	-	-	+
Checks (number)	-	-	+
Legal Risk			
Creditor rights	-	-	+
Contract enforcement days (ln)	+	+	-
Legal origin dummy (base: French)	-	-	+
Social Risk			
Physical Integrity Index	-	+	+
Empowerment Index	-	+	+
Civil liberties	+	-	-
Financial Risk			
Deposit money bank assets	-	-	+
Liquid liabilities to GDP	-	-	+
Private credit to GDP	-	-	+
Economic Risk			
Government balance to GDP	+	+	-
External debt to total exports	+	+	-
Economic growth	-	-	+
Fuel exports	-	-	+
Real GDP per capita (ln)	-	-	+
Inflation Rate	+	+	-
Population (ln)	-	-	+
International reserves	-	-	+
MDB dummy	-		+

Legend: (1) including the number of projects with MDB participation and the amount of financial support provided by MDB; (2) including the number of PPP projects and their investment value.

For practical purposes and in order to match all the available information on the dependent and independent variables, three different databases were constructed:

- The first has the unit of observation, the project, with 2095 observations and is used to explain the degree of private sector participation and the probability of a MDB participation in the project;
- The second concerns the total count of projects and the count of projects with MDB participation. Information was collected from 1990 to 2007, per country and year, with a total of 481 observations;
- The third collects information on PPP investments in infrastructure, per country/year, and in addition, on the amount of financial support provided by MDB, per country/year, with a total of 732 observations.

The last two databases constitute panel data, where observations were collected on the same developing countries over 1990 to 2007, resulting in two unbalanced panels, since for some countries data are only available for a smaller interval of time.[10] Therefore, a basic panel data method is used, namely the pooled approach, with clustered robust variances. The independence assumption of all the observations is relaxed and only independence between clusters (countries) is required.

Table 6.3 gives the general summary statistics for the larger database where the information for the dummies variables is also included (except time).

Table 6.3: Summary statistics

Variable	Number of observations	Mean	Std. Dev.	Min	Max
Degree of private participation	2095	0.880	0.247	0	1
MDB participation	2095	0.151	0.358	0	1
Political system	2095	0.611	0.885	0	2
Index Political Competitiveness	2095	6.860	0.556	1	7
Checks (number)	2095	4.599	3.620	1	18
Creditor rights	2095	1.550	0.943	0	4
Contract enforcement days (number)	2095	456.623	173.732	27	1459
Contract enforcement days (ln)	2095	6.065	0.349	3.296	7.286
English legal origin dummy	2095	0.286	0.452	0	1
French legal origin dummy	2095	0.630	0.483	0	1
German legal origin dummy	2095	0.034	0.182	0	1
Socialist legal origin dummy	2095	0.050	0.218	0	1
Physical Integrity Index	2095	3.311	2.196	0	8
Empowerment Index	2095	6.783	2.481	0	10
Civil liberties	2095	3.484	1.016	1	7
Deposit money bank assets	2095	0.857	0.122	0.124	1
Liquid liabilities to GDP	2095	0.428	0.241	0.076	1.295
Private credit to GDP	2095	0.379	0.307	0.028	1.660
General gov. balance /GDP (%)	2095	-2.278	4.446	-29.546	18.03534
External debt to total exports	2095	27.576	22.172	0.776	117.8147
Economic growth (%)	2095	4.510	3.670	-13.127	18.28661
Fuel exports (%)	2095	11.340	16.031	0	99.6565
Real GDP per capita	2095	2741.839	2088.723	126.1494	8699.013
Real GDP per capita (ln)	2095	7.534	0.968	4.837	9.071
Inflation Rate	2095	42.218	285.741	-23.479	6836.881
Population (10^3)	2095	189000	320000	1914.607	1110000
Population (ln)	2095	17.933	1.527	14.465	20.828
International reserves (months)	2095	5.206	2.393	0.372	13.833
Energy sector dummy	2095	0.418	0.493	0	1
Telecom sector dummy	2095	0.179	0.383	0	1
Transport sector dummy	2095	0.299	0.458	0	1
Water sector dummy	2095	0.105	0.306	0	1
East Asia and Pacific dummy	2095	0.174	0.379	0	1
Europe and Central Asia dummy	2095	0.111	0.314	0	1
Latin America & Caribbean dummy	2095	0.474	0.499	0	1
Middle East & North Africa dummy	2095	0.022	0.148	0	1
South Asia dummy	2095	0.152	0.359	0	1
Sub-Saharan Africa dummy	2095	0.065	0.247	0	1

[10]For information on which countries are included in each database, see the Data Appendix.

6.6 Results

All the regressions were performed using the statistical software STATA 11. Two preliminary notes: first, because correlation was expected among the observations within each country, clustered robust standard errors were used when possible, relaxing the independence assumption and only requiring observations to be not correlated between countries (clusters) and allowing for heteroscedasticity of unknown form between clusters. Second, because collinearity may cause problems turning the regression coefficients unreliable, a collinearity diagnostic was performed using the VIF (variance inflation factor) measure available in STATA.[11]

For the three databases, the results of the collinearity diagnostic performed reveal that region dummies show high levels of collinearity with VIF measures above 10, deserving correction. Therefore the regional dummies were excluded to improve the results accuracy. As already mentioned, the PPI database covers projects awarded in low and middle-income countries and these same countries are also classified in six regions (East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, South Asia, and Sub-Saharan Africa). Further, the World Bank's main criterion for classifying economies in low, middle or high income countries is gross national income (GNI) per capita, that was considered to be the best single indicator of economic capacity and progress. As a consequence, it was not surprising that regional dummies face high levels of collinearity with other measures of a country's economic and financial development, because besides the geographical dimension also to classify countries in one of these regions, an economic dimension was considered. In addition, neighboring developing / emerging countries usually present similarities in terms of institutional and social development.

For clarity purposes, the discussion of the results is divided in four sections. The first two sections exploring the findings concerning the determinants of agents' participation (private sector and MDB) in infrastructure PPP to developing countries. Next, the identification of which risk factors affect the number of PPP projects and the number of PPP with participation of MDB and finally, the same analysis concerning which risk factors influence overall investment flows and "aid" flows, expressed in financial support amounts provided by MDB to PPP.

[11] VIF is an indicator of how much of the inflation of the standard error could be caused by collinearity. As a rule of thumb, values above 10 should be a cause of concern and must be corrected.

6.6.1 The degree of private sector participation in PPP

The variable to be explained is the degree of private sector participation, which exhibits a highly asymmetric distribution, presenting a negative skewness measure of -2.22. This is because 72.6% of the observations are $y = 1$, and as such, the degree of private participation is under 100% for the remaining 27.4% of the observations in the sample.

The classical fractional response models (Logit, Probit, Cloglog) do not predict $y = 1$ but in practice one can consider that if the fitted values are very close to one, that corresponds to entirely private participation. Alternatively, Two-Part models can be used. One binary model to explain 1 *versus* not 1, and a classical fractional response model to explain the remaining 27.4% of the observations.

While theoretically the interpretation of $y = 1$ *vs* $y < 1$ is not completely straightforward, because it seems that a higher or lesser degree of private sector participation is the result of a utility maximization process by private investors, a closer analysis of the database reveals that observations with $y = 1$ are mostly concentrated in emerging countries (e.g. 15.6% of these projects are developed in Brazil, 13.4% in India and 10.4% in Argentina). As already mentioned the database includes projects developed in low and middle income countries, but strong asymmetries exist among countries and we may say that two different realities are covered with this data - on one hand, the database includes emerging economies and on the other hand, it includes the poorer developing countries. Without surprises, private investors prefer stronger commitments with emerging countries ($y = 1$). This rationale gives support to our choice of a Two-Part model.

Therefore, we use a classical fractional model, namely the Cloglog, and a Two-Part model, encompassing a Probit (dy) and a Fractional Cloglog ($y < 1$). The results of the regressions on the degree of private sector participation in infrastructure projects are presented in Table 6.4. This table presents the first set of regressions in columns 1 to 3 using the full specifications of the models mentioned. After these results, restricted models were estimated using only the variables that showed a t-statistic above 1, $|t| > 1$. For this second set of regressions, results are displayed in columns 4 to 6.

Table 6.4: Determinants of the degree of private sector participation in PPP infrastructure projects

Dependent variable:	Fractional	Two Part		Fractional	Two Part (rest)	
Degree of private	Cloglog	dy	$y < 1$	Cloglog (rest)	dy	$y < 1$
participation	(1)	(2)	(3)	(4)	(5)	(6)
Political system	-0.028	-0.048	0.004			
	(-0.61)	(-0.70)	(0.07)			
Index Political Competitiveness	0.036	-0.016	0.127			0.152*
	(0.74)	(-0.23)	(1.49)			(1.86)
Checks (number)	0.024**	0.029**	0.009	0.026***	0.030**	
	(2.48)	(2.14)	(0.49)	(3.27)	(2.41)	
Creditor rights	-0.056*	-0.087*	-0.005	-0.072**	-0.092**	
	(-1.72)	(-1.85)	(-0.11)	(-2.43)	(-2.12)	
Contract enforcement days (ln)	0.080	0.213*	-0.071		0.245**	
	(0.97)	(1.86)	(-0.65)		(2.23)	
English legal origin dummy	0.211**	0.370***	-0.003	0.162*	0.331***	0.011
	(2.25)	(2.75)	(-0.02)	(1.91)	(2.77)	(0.09)
German legal origin dummy	-0.480***	-0.831***	-0.101	-0.416***	-0.931***	-0.150
	(-3.66)	(-4.18)	(-0.60)	(-3.84)	(-5.34)	(-1.14)
Socialist legal origin dummy	-0.371***	-0.324*	-0.468**	-0.419***	-0.371**	-0.509***
	(-2.76)	(-1.74)	(-1.97)	(-3.45)	(-2.29)	(-2.73)
Physical Integrity Index	-0.035**	-0.049**	-0.019	-0.033**	-0.044*	
	(-2.12)	(-2.05)	(-0.77)	(-2.25)	(-1.88)	
Empowerment Index	-0.010	0.007	-0.037*			-0.031*
	(-0.70)	(0.33)	(-1.65)			(-1.75)
Civil liberties	-0.028	-0.009	-0.078			-0.072*
	(-0.75)	(-0.18)	(-1.51)			(-1.72)
Deposit money bank assets	-0.109	-0.293	0.180			
	(-0.45)	(-0.82)	(0.44)			
Liquid liabilities to GDP	-0.284	-0.558*	0.110	-0.425***	-0.720***	
	(-1.29)	(-1.71)	(0.37)	(-3.59)	(-3.80)	
Private credit to GDP	-0.113	0.001	-0.264			-0.167
	(-0.66)	(0.00)	(-1.09)			(-1.13)
General gov. balance to GDP	0.002	0.012	-0.005		0.011	
	(0.27)	(1.32)	(-0.54)		(1.33)	
External debt to total exports	0.002	0.002	0.004	0.001		0.004*
	(1.47)	(0.63)	(1.59)	(0.41)		(1.77)
Economic growth	0.006	0.009	-0.000			
	(0.78)	(0.77)	(-0.03)			
Fuel exports	-0.006***	-0.007***	-0.004	-0.005***	-0.008***	-0.004
	(-3.07)	(-2.84)	(-1.33)	(-3.15)	(-3.53)	(-1.31)
Real GDP per capita (ln)	0.131***	0.104*	0.143**	0.148***	0.121***	0.132**
	(3.11)	(1.68)	(2.34)	(4.75)	(2.64)	(2.51)
Inflation rate	-0.000	-0.000	0.000			
	(-0.47)	(-0.13)	(0.33)			
Population (ln)	-0.094***	-0.132***	-0.061	-0.064**	-0.124***	-0.046
	(-2.99)	(-3.02)	(-1.29)	(-2.54)	(-3.42)	(-1.57)
International reserves	0.008	0.009	0.002			
	(0.72)	(0.57)	(0.10)			
MDB dummy	0.153**	0.184**	0.159*	0.151**	0.179**	0.183**
	(2.46)	(2.01)	(1.80)	(2.46)	(1.96)	(2.04)
Energy sector dummy	-0.075	-0.313***	0.257**	-0.036	-0.307***	0.268**
	(-0.99)	(-2.92)	(2.03)	(-0.47)	(-2.89)	(2.16)
Telecom sector dummy	0.178**	0.061	0.374**	0.194**	0.080	0.428***
	(1.97)	(0.48)	(2.53)	(2.20)	(0.64)	(2.97)
Transport sector dummy	0.127	0.159	0.104	0.154*	0.163	0.135
	(1.60)	(1.42)	(0.72)	(1.91)	(1.46)	(0.92)
Time dummies	jointly not significant	jointly significant**	jointly not significant	not included	jointly significant***	not included
Constant	1.312	1.682	0.025	1.045**	0.985	-1.136
	(1.60)	(1.42)	(0.02)	(2.05)	(1.15)	(-1.36)
Number of observations	2095	2095	574	2095	2095	574
Log-Likelihood Value	-625.32	-1133.28	-287.97	-633.86	-1135.02	-291.05
Correlation(y yhat)^2	8.12%	8.58%	15.06%	6.70%	8.40%	12.03%
BIC	1579.48	2595.40	849.10	1390.08	2522.41	683.74
LR test^a				0.9292	0.9677	1.0000

Legend: * statistically significant at 10% level, ** at 5% level *** at 1% level. Robust t statistics in parentheses
^{a} p-values of the LR statistic comparing the full model specification with the restricted specification.

Where not directly provided by the statistical software, a measure of goodness-of-fit was computed through the square of the correlation between the observed response and the predicted response, what constitutes a general measure of the predictive power of the models.

It is worth to mention that concerning the fractional models, different specifications were also tried, like Logit and Probit. However testing for model adequacy, through the test known as the linktest, the Cloglog provides the best results with evidence of no misspecification, exhibiting a p-value=0.809 for the model in column (1) and a p-value=0.732 for the model in column (3).[12] This is not a surprising result, as already mentioned in Section 6.4, the Complementary Loglog model is not symmetric and increases sharply when $G(.)$ is near 1, providing the best fit to our data.

The estimates from the models show a consistent pattern and for almost all the variables, the sign of the effect is according to what was expected (see Table 6.2). Goodness-of-fit measures indicate that a Two-Part Model is better when compared with the "one-part" model, exhibiting a higher squared correlation between fitted and actual values. In respect to the Two-Part model, it should be noted that very different results are obtained for $y = 1$, meaning entirely private participation, and for $y < 1$, which gives support to the use of this method. In addition, given the high proportion of observations with $y = 1$ in the sample, strong similarities exist in the results between the "one-part" model and the Probit model, used to explain 1 *vs* not 1 (column 1 and 2).

The analysis of the results shows that the number of checks and balances is an important determinant of the degree of private sector participation, which is higher for countries with better governance quality. The empirical evidence also shows that countries with an English legal origin tend to attract more private sector participation. The legal protection provided by the common law of England is rewarded face to the French civil law system (the omitted class in the regressions). Following Djankov et al. (2007) and LaPorta et al. (1998), among others, common law systems tend to provide better protection to private investors. By contrast, countries with German and Socialist legal origins are penalized when compared with countries with a French legal origin.

[12] Linktest is a STATA procedure that performs a test for model specification. The idea behind linktest is that if the model is properly specified, one should not be able to find any additional predictors that are statistically significant. In addition, the adequacy of the link function is also tested.

In addition, private sector participation in PPP projects is higher for countries with higher GDP per capita and with less population, pointing to the fact that a higher degree of private sector participation occurs for projects developed in richer, but smaller markets. The market dimension is an important determinant of investment as shown by Neumayer (2003), Neumayer and Spess (2005) and Singh and Jun (1995). In these studies, population and GDP per capita are important determinants of foreign direct investment to developing countries. But contrary to what was expected, our results show the *Population* variable with the wrong sign. This coefficient is negative, suggesting that there is a bias favouring small countries in what concerns the degree of private sector involvement in PPP. A possible explanation is that some of the biggest countries are also characterized by poor policies and inversely, good governance and an adequate institutional framework tend to be more common in small countries, which face less ethnic conflicts and fractionalization.[13]

MDB involvement in PPP, as expected, is an economically and statistically important determinant of the degree of private sector participation. If a project have a MDB participation, this will have an effect of "umbrella" for all the project, acting like a mechanism of risk reduction, providing guarantees and as a sign of creditworthiness to private lenders, increasing their willingness to participate in the project.

Results for the sector dummies show that private sector participation is higher for telecommunications projects, when compared with the water and sewerage sector, although with a degree of participation not achieving 100%. A possible explanation is that usually that kind of projects need advanced and innovative technologies, requiring the expertise of the private sector. Sectors like energy and water tend to be "more public", given the politically sensitiveness of the goods to be provided. Interestingly, we may see that the energy sector coefficient change its sign in the two-parts of the model. For private sector involvement under 100%, energy projects are preferred over water and sewerage projects, and the opposite pattern is showed for private participation achieving 100%.

After these results, we rerun the models using only the explanatory variables that present $|t| > 1$, see columns 4 to 6 of Table 6.4. The LR tests performed comparing the full specification of the models with these restricted versions, show that the β_j associated with the variables not included in the restricted specifications, may be considered not significantly different from zero (all the p-values above 90%).

[13]The existence of conflicting interests that tend to fractionalize a society and is a focus of instability, riots and disturbances.

For the restricted models, results are very similar with those obtained with the full specifications. In general, the variables maintain their sign and the coefficients are of the same order of magnitude, albeit reinforcing their statistical significance. Slightly unexpected is the sign and significance of the coefficient on *Liquid liabilities to GDP*. Our results point to higher private sector participation in projects developed in countries that mobilize few domestic savings. An explanation could rest in the fact that private sector participation in infrastructure projects is essentially external participation and is the answer to overcome a lack of lending capacity in the home country.[14]

In addition, legal proxies as *Creditor rights* and *Contract enforcement days*, reinforce the statistical significance but maintain the wrong sign. Private sector participation is higher for countries with apparently poor legal environments. A possible interpretation to these results is presented by Subramanian et al. (2008), that show that Project Finance (PF) is mostly used in countries with weaker laws protecting investors. The organizational structure and the web of legal and financial contracts inherent to the arrangements provide a substitute for poor investor protection. This analysis may be extended, for the same reasons, to PPP arrangements (using PF mechanisms or not).

Next we turn our attention to the computation of average marginal effects (AME). Contrary to what happens with linear regression models, with nonlinear models the coefficients β_j, do not have a direct interpretation as the marginal effect - with nonlinear models, the marginal effects are nonlinear functions of the parameter estimates and levels of the explanatory variables. It should be noted that for dummy independent variables, the AME gives the discrete change rather than the marginal effect, i.e., for binary variables computes the discrete change when the variable changes from 0 to 1 (see Equation 6.11). Table 6.5 presents the average marginal effects to the statistically relevant variables.

[14]Esty (2003b) had already noted that international banks are more likely to finance projects in countries with less developed financial systems.

Table 6.5: Average Marginal Effects for the degree of private participation in PPP infrastructure projects

Dependent variable:	**Average Marginal Effect**			
degree of private participation	**Fractional Cloglog**	**Fractional Cloglog (rest.)**	**Two-Part Model (rest.) Probit**	**Cloglog**
Checks (number)	0.0056	0.0062	0.0091	
Index Political Competitiveness				0.0532
Creditor rights	-0.0129	-0.0169	-0.0280	
Contract enforcement days (ln)			0.0749	
English legal origin dummy	0.0464	0.0365	0.0964	
German legal origin dummy	-0.1358	-0.1173	-0.3281	
Socialist legal origin dummy	-0.1013	-0.1184	-0.1229	-0.1703
Physical Integrity Index	-0.0081	-0.0078	-0.0133	
Empowerment Index				-0.0110
Civil liberties				-0.0254
Liquid liabilities to GDP		-0.1000	-0.2198	
External debt to total exports				0.0012
Fuel exports	-0.0013	-0.0012	-0.0024	
Real GDP per capita (ln)	0.0304	0.0349	0.0368	0.0463
Population (ln)	-0.0218	-0.0150	-0.0378	
MDB dummy	0.0333	0.0335	0.0527	0.0645
Energy sector dummy			-0.0954	0.0942
Telecom sector dummy	0.0385	0.0423		0.1486
Transport sector dummy		0.0350		

From the table above, it is possible to see that, using as reference the Complementary loglog model (full specification):

- If a project has a MDB' participation, then the percentage points of private sector involvement increases on average by approximately 3.3%, all else held constant;
- If a country has an *English legal origin*, then the percentage points of private sector participation increases on average by 4.6%, comparing to *French legal origin* countries, while for *German* and *Socialist legal origin* countries, decreases on average by 13.6% and 10.1%, respectively, holding all other factors fixed;
- A 1% increase in *Population*, reduces on average the percentage points of private sector participation by 2%, all else held constant;
- If *Liquid liabilities to GDP* increases on average by 0.1, the percentage points of private sector participation will be reduced by 1%, all else held constant (restricted model).

Next, we test the effectiveness of each risk dimension through the joint nullity of the proxies associated with each risk. To accomplish that, Likelihood Ratio (LR) tests were performed with the full specifications of the Cloglog and of the Two-Part model (columns 1 to 3 from Table 6.4). It should be mentioned that the results are conditioned by the proxies used in this analysis, different proxies for each risk dimension could lead to different results. With this

caveat duly noted, the LR tests show that particularly relevant to explain the degree of private sector participation appear the legal and economic dimensions, as well as, sector dummies, corroborating our previous insights. In addition, the Probit model reveals that only the political and social dimensions are statistically negligible, distinguishing between $y = 1$ and $y < 1$ and as already mentioned, more similarities exist between the "one part" model (Cloglog) and the Probit model, given that near 73% of the observations are 1. LR tests are presented in Table 6.6.

Table 6.6: Likelihood Ratio tests for the degree of private sector participation in PPP infrastructure projects

Dependent variable:	**Fractional**	**Two-Part Model**	
Degree of private	**Cloglog**	**Probit**	**Cloglog**
participation	(N=2095)	(N=2095)	(N=574)
Risk dimensions:			
Political	LR chi2(3) = 4.39	LR chi2(3) = 4.66	LR chi2(3) = 0.90
	(0.2222)	(0.1983)	(0.8251)
Legal	LR chi2(5) = 16.38***	LR chi2(5) = 36.12***	LR chi2(5) = 1.63
	(0.0058)	(0.0000)	(0.8975)
Social	LR chi2(3) = 2.49	LR chi2(3) = 4.44	LR chi2(3) = 1.11
	(0.4765)	(0.2181)	(0.7739)
Financial	LR chi2(3) = 4.65	LR chi2(3) = 8.77**	LR chi2(3) = 0.47
	(0.1989)	(0.0325)	(0.9264)
Economic	LR chi2(8) = 19.91**	LR chi2(8) = 22.93***	LR chi2(8) = 4.86
	(0.0107)	(0.0035)	(0.7725)
Sector dummies	LR chi2(3) = 11.72***	LR chi2(3) = 44.23***	LR chi2(3) = 2.87
	(0.0084)	(0.0000)	(0.4115)
Time dummies	LR chi2(16) = 11.09	LR chi2(16) = 31.27**	LR chi2(16) = 4.43
	(0.8037)	(0.0124)	(0.9979)

Legend: p-values in brackets

6.6.2 The probability of a MDB participation in PPP

In this section, the variable to be explained is a binary variable - MDB participation in a PPP project. It is worth to mention that in the database, this variable is zero to 84.9% of the PPP projects (1779 observations of the total sample). MDB participate only in 316 PPP projects (15.1%), what is in line to our previous exposition in Section 6.2.

Table 6.7 presents the results of the regressions on the probability of structuring a PPP with a MDB participation. Again, each column presents a different specification: Logit, Probit and LPM (only as a benchmark). In column 4, the results of a restricted Logit model are showed.

Table 6.7: Determinants of MDB participation in PPP infrastructure projects

Dependent variable:				LOGIT
MDB participation	LOGIT	PROBIT	LPM	rest. model
	(1)	(2)	(3)	(4)
Political system	0.020	0.013	0.011	
	(0.17)	(0.20)	(0.62)	
Index Political Competitiveness	0.090	0.050	0.009	
	(0.71)	(0.72)	(0.57)	
Checks (number)	-0.047	-0.026*	-0.002	-0.039
	(-1.54)	(-1.66)	(-0.75)	(-1.18)
Creditor rights	-0.191*	-0.106*	-0.032**	-0.198**
	(-1.87)	(-1.91)	(-2.13)	(-2.01)
Contract enforcement days (ln)	0.378***	0.215***	0.068***	0.397***
	(2.85)	(2.90)	(2.96)	(3.13)
English legal origin dummy	0.080	0.045	0.021	0.067
	(0.32)	(0.31)	(0.57)	(0.31)
German legal origin dummy	-0.592*	-0.324*	-0.104**	-0.648**
	(-1.93)	(-1.87)	(-2.39)	(-2.55)
Socialist legal origin dummy	-0.989**	-0.486**	-0.106*	-1.114***
	(-2.55)	(-2.35)	(-1.90)	(-3.67)
Physical Integrity Index	0.001	0.001	0.002	
	(0.03)	(0.05)	(0.32)	
Empowerment Index	-0.090**	-0.048**	-0.012*	-0.086*
	(-2.06)	(-1.98)	(-1.89)	(-1.78)
Civil liberties	-0.206*	-0.104	-0.025*	-0.187*
	(-1.67)	(-1.48)	(-1.73)	(-1.68)
Deposit money bank assets	0.203	0.064	-0.007	
	(0.32)	(0.18)	(-0.07)	
Liquid liabilities to GDP	0.278	0.026	-0.008	
	(0.33)	(0.06)	(-0.09)	
Private credit to GDP	-1.414**	-0.680**	-0.135**	-1.177***
	(-2.29)	(-2.19)	(-2.04)	(-3.71)
General government balance to GDP	0.027	0.016	0.003	0.021
	(1.22)	(1.38)	(1.22)	(1.14)
External debt to total exports	0.005	0.002	0.000	
	(0.96)	(0.83)	(0.58)	
Economic growth	0.001	0.002	-0.001	
	(0.05)	(0.15)	(-0.28)	
Fuel exports	-0.006	-0.003*	-0.001*	-0.007**
	(-1.52)	(-1.65)	(-1.68)	(-2.10)
Real GDP per capita (ln)	-0.318***	-0.172***	-0.046***	-0.228**
	(-2.96)	(-2.84)	(-3.08)	(-2.56)
Inflation rate	-0.000	-0.000	-0.000	
	(-0.85)	(-0.97)	(-1.43)	
Population (ln)	-0.368***	-0.202***	-0.052***	-0.322***
	(-4.03)	(-3.79)	(-3.87)	(-5.25)
International reserves	-0.072*	-0.034*	-0.008*	-0.075*
	(-1.93)	(-1.66)	(-1.79)	(-1.85)
Energy sector dummy	0.030	0.030	0.004	
	(0.07)	(0.12)	(0.08)	
Telecom sector dummy	-0.235	-0.117	-0.026	
	(-0.56)	(-0.49)	(-0.53)	
Transport sector dummy	0.017	-0.001	0.003	
	(0.05)	(-0.00)	(0.07)	
Time dummies	jointly	jointly	jointly	jointly
	significant**	significant**	significant**	significant***
Constant	5.763**	3.022**	1.198***	4.597***
	(2.14)	(2.03)	(3.19)	(2.86)
Number of observations	2095	2095	2095	2095
Log-Likelihood Value	-804.27	-805.42	-730.41	-806.56
Percent correctly predicted	84.82%	84.77%		84.63%
(Pseudo) R-Squared	9.49%	9.36%	8.20%	9.23%
BIC	1929.72	1932.02	1782.00	1850.19
LR test[a]				0.9493

Legend: * statistically significant at 10% level, ** at 5% level *** at 1% level.
[a] p-values of the LR statistic comparing the full model specification with the restricted specification.
Clustered robust t statistics in parentheses.

The qualitative results of Logit and Probit specifications (column 1 and 2) are very similar with goodness-of-fit measures very close - percent correctly predicted around 85% and Pseudo R-Squared around 9.5%. In addition, in what concerns model specification, both models seem to be appropriate to model our data. The linktest performed show no evidence of misspecification problems either for the Logit and Probit models.

In general, the signs of the coefficients are accordingly to what was expected. The main results point to a strong support of the economic dimension, meaning that economic risk seems to be the most relevant factor. As expected, richer (measured by GDP per capita) and more populous countries tend to have projects with lower participation of MDB. These findings are according to Neumayer (2003) results - in a study of aid flows from regional multilateral development banks, the author reported that are the countries with lower per capita income that received more aid flows and a bias towards less populous countries was evident. Concerning international reserves, the lower the level of a country's reserves, more difficult will be the access to international loans. Therefore, if a country is in a fragile payment position this will be translated to increased difficulties in borrowing from external sources, making a MDB participation more needed. Our results corroborate this idea, the probability of a MDB participation in a PPP is higher for countries with lower international reserves.

The legal dimension is the other important driver of MDB participation. Accordingly to our results, countries with higher legal risk measured by the index of creditor rights and the number of days to enforce a contract, have a higher probability of a MDB participation in a PPP project. In addition, there is evidence that the legal origin of a country matters.

In the financial dimension, more developed financial countries, as measured by private credit to GDP, have a lower probability of MDB participation in PPP projects, as expected. Where the domestic financial and capital markets are relatively underdeveloped, the capacity for local financing of large scale private investments will be constrained, therefore, a relatively higher probability of MDB participation will be expected, other things being equal.

In what concerns human rights variables, statistically significant appear the *Empowerment index* and the *Civil liberties* measure, although exhibiting controversial signs. On one hand, countries that show a higher *Empowerment Index*, also have a lower probability of a MDB participation in a PPP, thus, MDB participation seems to be a response to the level of social risk. On the

other hand, the coefficient on *Civil liberties* indicates that MDB involvement may be considered as a way of reward countries that prove to respect more human rights, like initially expected.

In respect to the time dummies, there is evidence of the time explaining the probability of MDB participation (individual coefficients not reported).

After these conclusions, we run a restricted form of the Logit model using only the potential statistical significant variables, with $|t| > 1$ (column 4 of Table 6.7). The results are very close to the results obtained with the full specification and in addition, the LR test performed shows that the restricted model is not rejected (p-value=0.9493).

Table 6.8 presents the average marginal effects to the statistically relevant variables, allowing comparisons between models, what is not possible with the results of the Table 6.7.

Table 6.8: Average Marginal Effects for the probability of MDB participation in PPP infrastructure projects

Dependent variable:	**Average Marginal Effect**		
MDB participation	**LOGIT**	**PROBIT**	**LOGIT (rest.)**
Creditor rights	-0.0223	-0.0225	-0.0232
Contract enforcement days (ln)	0.0441	0.0457	0.0465
English legal origin dummy	0.0095	0.0096	0.0079
German legal origin dummy	-0.0587	-0.0595	-0.0633
Socialist legal origin dummy	-0.0876	-0.0828	-0.0954
Empowerment Index	-0.0106	-0.0103	-0.0101
Civil liberties	-0.0241		-0.0218
Private credit to GDP	-0.1653	-0.1445	-0.1379
Fuel exports		-0.0007	-0.0008
Real GDP per capita (ln)	-0.0371	-0.0366	-0.0267
Population (ln)	-0.0430	-0.0429	-0.0377
International reserves	-0.0085	-0.0073	-0.0087

The results show that, in general, the magnitude of the effect is very small and more precisely for the Logit (Model 1):

- Increasing real GDP per capita in 1%, decreases on average the probability of MDB participation by 3.7%, approximately, all else held constant;
- If the number of days to enforce a contract increases by 1%, the probability of a MDB participation increases on average by approximately 4.4%, *ceteris paribus*;
- If a country is 1% more populous, the probability of a MDB to participate in a PPP infrastructure project is on average 4.3% less, approximately, holding all other factors fixed;

- Particularly significant is the magnitude of the *Private credit to GDP* coefficient - if this variable increases by 0.1 (more developed financial countries), this will reduce the probability of a MDB participation in about 1.7%, on average, controlling for all the other relevant factors.

Taking into account all the aspects previously mentioned concerning this type of analysis, LR tests were performed using Logit full specification, to assess the overall significance of each risk dimension, as well as the dummies relevance (results are presented in Table 6.9). As already noted, the conclusions of this analysis rely crucially on the proxies used for each risk dimension.

Table 6.9: Likelihood Ratio tests for MDB participation in PPP infrastructure projects

Dependent variable: **MDB participation**	**LOGIT** Full model (N=2095)
Risk dimensions:	
Political	LR chi2(3) = 2.18 (0.5363)
Legal	LR chi2(5) = 19.47*** (0.0016)
Social	LR chi2(3) = 6.14 (0.1052)
Financial	LR chi2(3) = 13.53*** (0.0036)
Economic	LR chi2(8) = 43.53*** (0.0000)
Sector dummies	LR chi2(3) = 2.04 (0.5641)
Time dummies	LR chi2(16) = 27.28** (0.0385)

Legend: *p*-values in brackets

The economic, legal and financial risk dimensions appear as the most relevant, to explain the probability of a MDB participation in a PPP, confirming our hypotheses 3 and 5 (see Section 6.3). By contrast, the political environment does not play a determinant role explaining the MDB participation (rejecting the hypothesis 1) and more importantly, human rights variables jointly seem do not matter in explaining the probability of a MDB involvement in a project, contradicting the idea that their participation is higher for countries that are more socially responsible, given their role as "development" banks (rejecting the hypothesis 7). Nevertheless, it should be noted that individually, some of these variables have a statistically significant effect as already discussed.

6.6.3 Determinants of the number of PPP projects

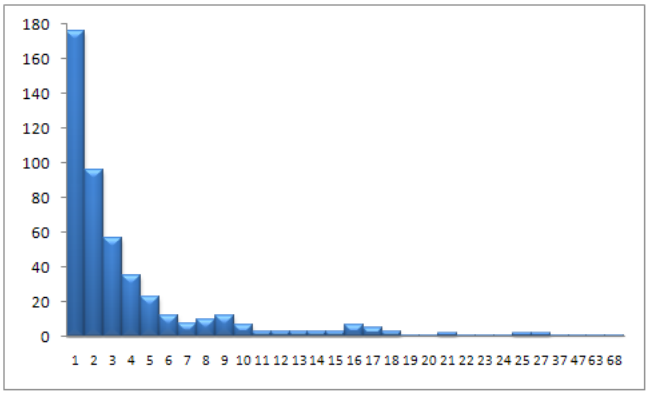
In this section, the dependent variable is the number of projects per country and year, and additionally, the number of projects with MDB participation per country and year. Some descriptive statistics are presented in Table 6.10.

Table 6.10: Descriptive statistics for the number of projects

Dependent variable	Number of observations	Mean	Variance	Skewness	Kurtosis	Min	Max
Number of projects	481	4.3555	43.9671	4.8841	37.4656	1	68
Number of projects with MDB	481	0.7838	1.5115	3.1441	17.3718	0	9

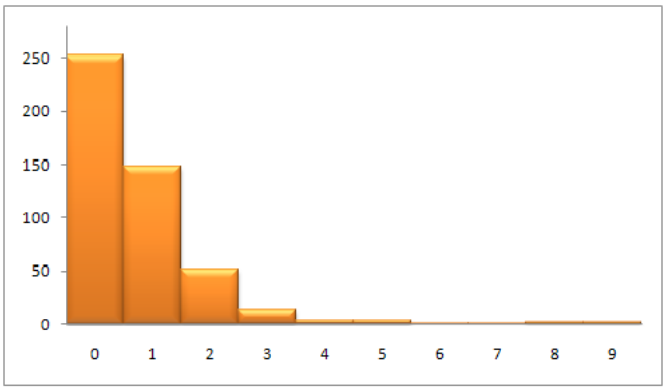
As it is possible to see, the data to be used as the dependent variables in the next regressions, are overdispersed, situation where the variance is significantly larger than the mean. To corroborate this conclusion, the following figures present the frequency distributions of the two variables (see the figures below). Both distributions have long right tails. For y as the number of projects, the natural starting point is one with the proportion of ones achieving 36.6% of the total, and in addition, 90% of all the observations are under 10 (Figure 6.9).

Figure 6.9: Histogram of the number of PPP projects



When we consider y as the number of projects with MDB participation, the data show a peak in zero with 52.6% of the total, and 97% of the observations are under 3 (see Figure 6.10). Given the fact that the majority of the observations are concentrated in the lower values of the distributions, it is possible to create categories for the dependent variables, allowing the application of ordered response models, namely, Probit and Logit. These models allow more flexibility, as they do not impose strong assumptions in the underlying distribution of the counts, feature which constitutes their main advantage.

Figure 6.10: Histogram of the number of PPP projects with MDB



First of all, some grouping of counts is done in order to limit the number of categories. For y as the total number of projects per country and year, the original 30 categories were reduced to just 11, ignoring the higher frequencies that collectively account for less than 10% of the number of projects. It should be noted that the last 12 original categories, for total count of projects ranging from 19 to 68, the observations in each category are just 2 or 1, and are here assembled in one class (>10). See Table 6.11.

Table 6.11: Frequency distribution for the total number of projects

Ordered data			
Number of Projects	**Freq.**	**Percent**	**Cum.**
1	176	36.59	36.59
2	96	19.96	56.55
3	57	11.85	68.4
4	35	7.28	75.68
5	23	4.78	80.46
6	12	2.49	82.95
7	8	1.66	84.62
8	10	2.08	86.69
9	12	2.49	89.19
10	7	1.46	90.64
>10	45	9.36	100
Total	**481**	**100**	

In respect to y as the number of projects with MDB participation per country and year, from the original 10 categories (counts ranging from 0 to 9), four classes were created, as follows:

Table 6.12: Frequency distribution for the number of projects with MDB participation

Ordered data			
Number Projects with MDB	**Freq.**	**Percent**	**Cum.**
0	253	52.6	52.6
1	148	30.77	83.37
2	52	10.81	94.18
>=3	28	5.82	100
Total	**481**	**100**	

Table 6.13 presents the results of the regressions on the total number of projects per country and year. As a starting point, Ordered Probit and Ordered Logit models (column 1 and 2) are used. In addition, the Zero Truncated Negative Binomial (ZTNB) model is also a good candidate to fit count data when zeros are not observed due to the sampling process.[15] However, because convergence problems appeared with the full specification of the ZTNB, it was only possible to compute restricted forms of this model (column 3 and 5). Column 4 presents also a restricted form of the Ordered Probit model for comparisons purposes.

Both models, Ordered Probit and Ordered Logit, provide similar results concerning the sign and significance of the coefficients. In addition, measures of goodness of fit ($pseudo - R^2$ or BIC) are very close and the same conclusion is obtained concerning the fitted probabilities (results in next Table 6.14). Nevertheless, the Ordered Probit seems to provide a better fit to the data. When the ZTNB model is used, no particular improvement is achieved in respect to the statistically relevant variables, although the squared correlation between the fitted and actual values is higher (62,17%) for this model.

In addition, comparing the results of column 1 and 3 with the restricted specifications (column 4 and 5), it is possible to see strong similarities among the results. For these restricted forms, we included only the variables that exhibit $|t| > 1$ in the first set of regressions. In general, the variables and time dummies (jointly) maintain their statistical significance, with the exception of *Private Credit to GDP* that gains statistical relevance in the restricted version – countries with more developed financial systems foster the number of infrastructure PPP.

[15]Concerning Zero Truncated models, our choice rest on the ZTNB. The LR test performed shows evidence of overdispersion, providing support to the superiority of the ZTNB specification over the Zero Truncated Poisson.

Table 6.13: Determinants of the number of PPP infrastructure projects

Dependent variable: **Number of projects**	Ordered PROBIT (1)	Ordered LOGIT (2)	ZTNB[a] rest. model 1 (3)	Ord PROBIT rest. model (4)	ZTNB[a] rest. model 2 (5)
Political system	0.047	0.075	-0.077		
	(0.31)	(0.25)	(-0.41)		
Index Political Competitiveness	0.047	0.101	0.135*		0.141*
	(0.52)	(0.67)	(1.72)		(1.94)
Checks (number)	0.077**	0.128**	0.070***	0.105***	0.069***
	(2.42)	(2.20)	(3.63)	(3.83)	(3.79)
Creditor rights	-0.124	-0.226	-0.108*	-0.122	-0.117
	(-1.60)	(-1.56)	(-1.70)	(-1.60)	(-1.49)
Contract enforcement days (ln)	0.231*	0.417*	0.210	0.220	0.221
	(1.73)	(1.77)	(1.26)	(1.47)	(1.23)
English legal origin dummy	0.010	0.026	-0.044	0.022	-0.076
	(0.04)	(0.06)	(-0.19)	(0.12)	(-0.42)
German legal origin dummy	-0.582	-1.110	-0.495	-0.446	-0.491
	(-1.36)	(-1.32)	(-1.00)	(-1.05)	(-1.10)
Socialist legal origin dummy	0.505*	0.899*	0.502*	0.394	0.475*
	(1.78)	(1.78)	(1.79)	(1.60)	(1.74)
Physical Integrity Index	0.011	0.009			
	(0.22)	(0.10)			
Empowerment Index	0.011	0.016			
	(0.34)	(0.28)			
Civil liberties	-0.055	-0.113			
	(-0.48)	(-0.55)			
Deposit money bank assets	0.204	0.308	-0.094		
	(0.40)	(0.34)	(-0.19)		
Liquid liabilities to GDP	0.215	0.502	0.407		
	(0.28)	(0.35)	(0.60)		
Private credit to GDP	0.596	0.926	0.492	0.823**	0.716**
	(1.15)	(0.97)	(1.11)	(2.40)	(2.23)
General gov. balance to GDP	-0.063***	-0.112***	-0.058***	-0.066***	-0.056***
	(-4.51)	(-4.03)	(-4.17)	(-4.47)	(-3.91)
External debt to total exports	0.010	0.015	0.007	0.011	0.008
	(1.31)	(1.13)	(1.56)	(1.35)	(1.57)
Economic growth	0.032**	0.064***	0.025*	0.034**	0.026*
	(2.45)	(2.80)	(1.89)	(2.55)	(1.84)
Fuel exports	-0.002	-0.003	-0.001		
	(-0.31)	(-0.26)	(-0.32)		
Real GDP per capita (ln)	0.412***	0.743***	0.525***	0.448***	0.510***
	(3.08)	(3.16)	(5.51)	(3.89)	(4.97)
Inflation rate	-0.000	-0.000	-0.000		
	(-0.56)	(-0.54)	(-0.18)		
Population (ln)	0.560***	0.987***	0.550***	0.531***	0.539***
	(7.02)	(6.25)	(9.62)	(7.29)	(9.66)
International reserves	0.067*	0.113*	0.053*	0.063*	0.054
	(1.86)	(1.71)	(1.71)	(1.65)	(1.56)
Time dummies	jointly significant***	jointly significant***	jointly significant***	jointly significant***	jointly significant***
Constant			-15.537***		-15.470***
			(-9.88)		(-10.11)
Number of observations	481	481	481	481	481
Log-likelihood value	-748.46	-748.71	-887.37	-750.68	-888.33
Pseudo R-Squared	17.86%	17.83%	16.76%	17.61%	16.67%
Correlation(y yhat)^2	36.76%	34.95%	62.17%	36.99%	60.64%
BIC	1793.37	1793.86	2003.24	1742.22	1974.30
LR test[b]				0.8808	0.8588

Legend: * statistically significant at 10% level, ** at 5% level *** at 1% level.
[a] Zero Truncated Negative Binomial.
[b] p-values of the LR statistic comparing the full model specification with the restricted specification.
Clustered robust t statistics in parentheses.

A more detailed analysis of the results reveals a strong support of the economic variables in explaining the number of PPP projects per country and year. More precisely richer, larger markets and with more prospects of economic growth are more appealing to the development of PPP. All these results are in line with what was expected and moreover, confirm the previous insights of Hammami et al. (2006) that also stress the importance of these economic variables. In addition, governments facing high deficit levels are more interested in PPP for the development of infrastructure projects, otherwise unaffordable, but this is a factor of economic instability and high deficit levels may become unsustainable over time. Therefore, a negative sign on this coefficient means that these countries are penalized – the number of PPP projects is decreasing with the deficit level.

Concerning the institutional environment, the number of checks and balances is also an important determinant of the total count of PPP, that shows an increasing trend for more accountable and more transparent governments. As expected, these countries provide a better environment for the development of such partnerships.

Sightly unexpected is the sign of the legal variables, but these results may be interpreted following the empirical analysis of Subramanian et al. (2008), already mentioned in Section 6.6.1, where the weak legal environment is circumvented by the contractual structure inherent to PPP.

In respect to time-dummies, there is a strong support of the importance of time-specific global shocks that appear as systemic drivers of the number of PPP projects developed. Although the individual coefficients are not reported, they are mostly statistically significant and show a positive sign, meaning an increasing trend on the total number of projects when compared with the base year of 1990, and reflecting periods of both boom and crisis, as the previous Figure 6.5 highlighted.

Table 6.14 presents the predicted probabilities for each of the outcomes. Comparing these values with the sample frequencies of Table 6.11, expressed as a percentage, the reported values are very close. Higher probabilities are attached to the first categories, where the most likely category is $y = 1$ with a probability of 36%, interpreted as the probability for a country to have just one PPP project per year.

Table 6.14: Predicted probabilities for the number of projects

Outcome	**Average Probability**	
	Ordered Probit	Ordered Logit
Pr (number=1)	0.363	0.359
Pr (number=2)	0.187	0.186
Pr (number=3)	0.122	0.120
Pr (number=4)	0.077	0.077
Pr (number=5)	0.051	0.051
Pr (number=6)	0.027	0.027
Pr (number=7)	0.018	0.018
Pr (number=8)	0.023	0.023
Pr (number=9)	0.028	0.028
Pr (number=10)	0.016	0.017
Pr (number>10)	0.088	0.092
Total	1.000	1.000

The average marginal effects computed for the Ordered Probit (Model 1) are given in Table 6.15. As already mentioned, for ordered response models, the computation of AME is done for each outcome. It allows answer to the question of what is the effect on the probabilities of having different counts of PPP projects per country/year, if one regressor increases by one unit, while holding the other factors unchanged.

Table 6.15: Average Marginal Effects for the Number of PPP projects

Dependent variable:	**ORDERED PROBIT (Model 1)**					
Number of projects	$\Pr(y=1)$	$\Pr(y=2)$	$\Pr(y=3)$	$\Pr(y=4)$	$\Pr(y=5)$	$\Pr(y=6)$
Checks (number)	-0.0199	-0.0003	0.0022	0.0024	0.0021	0.0013
Contract enforcement days (ln)	-0.0598	-0.0010	0.0067	0.0073	0.0062	0.0038
General gov. balance to GDP	0.0163	0.0003	-0.0018	-0.0020	-0.0017	-0.0010
Economic growth	-0.0084	-0.0001	0.0009	0.0010	0.0009	0.0005
Real GDP per capita (ln)	-0.1069	-0.0018	0.0119	0.0130	0.0111	0.0068
Population (ln)	-0.1453	-0.0024	0.0162	0.0177	0.0151	0.0092
International reserves	-0.0174	-0.0003	0.0019	0.0021	0.0018	0.0011
	$\Pr(y=7)$	$\Pr(y=8)$	$\Pr(y=9)$	$\Pr(y=10)$	$\Pr(y>10)$	TOTAL
Checks (number)	0.0009	0.0012	0.0016	0.0024	0.0075	0.00
Contract enforcement days (ln)	0.0027	0.0036	0.0049	0.0073	0.0226	0.00
General gov. balance to GDP	-0.0007	-0.0010	-0.0013	-0.0020	-0.0061	0.00
Economic growth	0.0004	0.0005	0.0007	0.0010	0.0032	0.00
Real GDP per capita (ln)	0.0048	0.0065	0.0087	0.0130	0.0404	0.00
Population (ln)	0.0066	0.0089	0.0118	0.0177	0.0549	0.00
International reserves	0.0008	0.0011	0.0014	0.0021	0.0066	0.00

The analysis of the AME presented above confirms our previous analysis. Variables like *Checks, Economic growth, Real GDP per capita, Population* and *International Reserves* only present negative signs for the probabilities of $y = 1$ and $y = 2$, what means that increasing these variables will increase the probability for higher counts of projects. Countries with more accountable governments and with an economic environment characterized by lower risk, increase the likelihood of a greater number of PPP projects being developed. The deficit level has the opposite effect.

To highlight if the same factors that drive the number of PPP projects developed per country/year, are the same that influence the number of projects with MDB participation, we run the same regressions (Ordered models) and a standard Negative Binomial regression. Results are presented in Table 6.16. In addition, columns 4 and 5, present restricted specifications of these models.

The analysis of the results across the full specifications (column 1 to 3) shows a consistent pattern, comparing coefficients, their statistical significance and measures of goodness-of-fit of the models, with an apparent superiority of the standard Negative Binomial regression, if we consider the $Pseudo - R^2$ or the measure of squared correlation. If the analysis is focused in the LL value or BIC, then the Ordered Probit is preferred.

For the restricted models, comparing column 4 to 5 of Table 6.16, very close results are presented. If we compare with specifications of the full model (1 and 3), economic variables that seem to gain statistical relevance include *External debt, Economic growth* and *Fuel exports*.

In general, the results show that still particularly relevant are the economic variables, explaining the number of projects with MDB participation. Nevertheless, factors that are important economic determinants of the probability of the MDB participation in PPP, such as *Real GDP per capita* or *Population*, do not have an important explaining role in this context (recall Section 6.6.2).

If we compare these results with the determinants of the total count of projects, no significant match appear - variables that are statistically relevant and of the same order of magnitude, just include *Contract enforcement days* and *Economic growth*. Nevertheless, it should be noted that indicators of macroeconomic stability like *Inflation* or *Fuel exports*, appear more relevant in explaining the number of projects in which MDB participate than in explaining the total count of projects. In addition and as expected, governments facing higher debt levels, choose to develop more PPP with the participation of MDB, in an effort to attract private funding.

Table 6.16: Determinants of the number of PPP infrastructure projects with MDB

Dependent variable: **Number of projects** **with MDB participation**	Ordered Probit (1)	Ordered Logit (2)	Negative Binomial (3)	Ord. Probit rest. model (4)	Neg. Binomial rest. model (5)
Political system	-0.001	0.000	-0.029		
	(-0.01)	(0.00)	(-0.24)		
Index Political Competitiveness	0.025	0.031	0.091		
	(0.33)	(0.24)	(0.93)		
Checks (number)	0.015	0.022	0.029		0.042*
	(0.55)	(0.45)	(1.04)		(1.75)
Creditor rights	-0.098	-0.191	-0.119	-0.111*	-0.123
	(-1.29)	(-1.32)	(-1.50)	(-1.92)	(-1.59)
Contract enforcement days (ln)	0.241**	0.376*	0.248**	0.306**	0.260**
	(2.14)	(1.90)	(2.04)	(2.43)	(2.15)
English legal origin dummy	-0.070	-0.096	-0.096		-0.145
	(-0.33)	(-0.26)	(-0.40)		(-0.67)
German legal origin dummy	-0.354	-0.483	-0.549		-0.488
	(-0.98)	(-0.75)	(-1.34)		(-1.28)
Socialist legal origin dummy	-0.069	-0.147	-0.157		-0.158
	(-0.30)	(-0.38)	(-0.60)		(-0.76)
Physical Integrity Index	0.013	0.026	0.018		
	(0.30)	(0.32)	(0.37)		
Empowerment Index	0.019	0.032	-0.003		
	(0.49)	(0.46)	(-0.07)		
Civil liberties	-0.034	-0.045	-0.027		
	(-0.33)	(-0.25)	(-0.26)		
Deposit money bank assets	0.240	0.375	0.103		
	(0.58)	(0.54)	(0.23)		
Liquid liabilities to GDP	0.015	-0.120	0.106		
	(0.03)	(-0.14)	(0.19)		
Private credit to GDP	-0.508	-0.750	-0.665*	-0.285	-0.549*
	(-1.52)	(-1.24)	(-1.83)	(-1.17)	(-1.66)
General government balance to GDP	-0.017	-0.027	-0.026*	-0.005	-0.024
	(-1.32)	(-1.12)	(-1.67)	(-0.44)	(-1.49)
External debt to total exports	0.016**	0.029**	0.015***	0.023***	0.015***
	(2.04)	(2.11)	(3.22)	(3.16)	(3.42)
Economic growth	0.031*	0.051	0.034*	0.035**	0.036*
	(1.74)	(1.64)	(1.93)	(1.97)	(1.92)
Fuel exports	-0.006*	-0.011*	-0.007*	-0.007***	-0.008**
	(-1.82)	(-1.82)	(-1.91)	(-2.65)	(-2.41)
Real GDP per capita (ln)	0.073	0.105	0.151		0.190*
	(0.76)	(0.62)	(1.46)		(1.94)
Inflation rate	-0.000*	-0.001*	-0.000***	-0.000	-0.000**
	(-1.89)	(-1.89)	(-2.70)	(-1.46)	(-2.30)
Population (ln)	0.072	0.100	0.118		0.097
	(0.88)	(0.69)	(1.29)		(1.38)
International reserves	0.026	0.043	0.024		
	(0.90)	(0.82)	(0.83)		
Time dummies	jointly significant**	jointly significant*	jointly significant**	jointly significant**	jointly significant**
Constant			-6.370***		-5.716***
			(-2.84)		(-3.94)
Number of observations	481	481	481	481	481
Log likelihood value	-481.77	-484.27	-527.33	-486.37	-528.45
Pseudo R-Squared	9.49%	9.02%	10.27%	8.63%	10.08%
Correlation(y yhat)^2	18.56%	18.11%	28.09%	16.80%	27.85%
BIC	1216.76	1221.75	1301.69	1139.49	1254.52
LR test^a				0.8182	0.9729

Legend: * statistically significant at 10% level, ** at 5% level *** at 1% level.
^{a} p-values of the LR statistic comparing the full model specification with the restricted specification.
Clustered robust t statistics in parentheses.

Predicted probabilities for each of the four outcomes are given in Table 6.17. Comparing these values with the sample frequencies of Table 6.12 show that the average predicted probabilities

are within 0.05 of the sample frequencies for each outcome. The most likely category is $y = 0$ with a probability of 52%, meaning that the highest probability is for *no* MDB participation in a PPP project.

Table 6.17: Predicted probabilities for the number of projects with MDB participation

Outcome	**Average Probability**	
	Ordered Probit	Ordered Logit
Pr ($y = 0$)	0.524	0.522
Pr ($y = 1$)	0.306	0.306
Pr ($y = 2$)	0.113	0.113
Pr ($y \geq 3$)	0.057	0.059
Total	1.000	1.000

The computation of average marginal effects, only to the statistically relevant variables, highlights that all the coefficients have a very small magnitude, except *Contract enforcement days*.

Table 6.18: Average Marginal Effects for the Number of PPP projects with MDB

Dependent variable:	**ORDERED PROBIT (Model 1)**				
Number of projects with MDB participation	Pr ($y = 0$)	Pr ($y = 1$)	Pr ($y = 2$)	Pr ($y \geq 3$)	TOTAL
Contract enforcement days (ln)	-0.0835	0.0308	0.0291	0.0236	0.00
External debt to total exports	-0.0056	0.0021	0.0020	0.0016	0.00
Economic growth	-0.0109	0.0040	0.0038	0.0031	0.00
Fuel exports	0.0021	-0.0008	-0.0007	-0.0006	0.00
Inflation Rate	0.0001	0.0000	0.0000	0.0000	0.00

Taking into consideration the constraints inherent to this analysis, Table 6.19 presents a summary of the LR tests performed with the Ordered Probit model.[16]

Table 6.19: Likelihood Ratio tests for the number of projects

LR tests (Ordered Probit - full model) N=481	**Dependent variable** **Number of PPP projects**	**Number of projects with MDB participation**
Risk dimensions: Political	LR chi2(3) = 7.69* (0.0529)	LR chi2(3) = 0.43 (0.9348)
Legal	LR chi2(5)= 11.72** (0.0388)	LR chi2(5) = 7.43 (0.1904)
Social	LR chi2(3) = 1.21 (0.7494)	LR chi2(3)= 1.08 (0.7820)
Financial	LR chi2(3) = 11.08** (0.0113)	LR chi2(3) = 3.43 (0.3296)
Economic	LR chi2(8)= 134.14*** (0.0000)	LR chi2(8)= 29.54*** (0.0003)
Time Dummies	LR chi2(16) = 63.27*** (0.0000)	LR chi2(16) = 27.62** (0.0351)

Legend: * statistically significant at 10% level, ** at 5% level *** at 1% level, *p*-values in brackets

[16]The constrains mentioned in Section 6.6.1 are extensive to all the similar analyses.

The results show evidence in favor of all the risk dimensions as important determinants of the total number of projects, with the exception of the social risk dimension. Particularly relevant appear to be the economic dimension, as well as, time-specific dummies. Concerning the number of projects in which MDB participate, evidence favors also economic variables and the time-effect.

6.6.4 Determinants of investments in PPP

In this section a step ahead is given for a deeper analysis of PPP determinants, by using as dependent variables the total value of investments and the total amount of MDB financial support per country and year (all expressed in real terms). Some descriptive statistics are presented in Table 6.20.

Table 6.20: Descriptive statistics for PPP investments and MDB financial support

Dependent variable (*)	Number of observations	Mean	Std. Dev.	Skewness	kurtosis	Min	Max
Investment	732	37838.81	577121	18.44	375.14	0	12900000
Investment (y>0)	679	40792.35	599153	17.76	347.86	0.15	12900000
ln (investment)	679	4.95	2.24	0.41	5.01	-1.88	16.38
MDB support	732	33.34	162.17	19.62	464.92	0	3944.79
MDB support (y>0)	286	85.34	250.99	12.96	197.22	0.28	3944.79
ln (MDB support)	286	3.46	1.46	-0.38	3.61	-1.28	8.28

Legend: (*) Expressed in real USD values

When y is the dollar value of investments in PPP projects, we have to consider the following:

- investment values are zero for 53 observations (7.24% of the sample);
- the positive values are very right-skewed and with the logarithmic transformation, skewness is reduced from 17.76 to 0.41 and the kurtosis is 5.01, more close to the normal value of 3.

Similar considerations can be made concerning the amount of financial support provided by MDB. The majority of the sample observations assume the zero value (60.93% of the 732 observations) and the positive values are very heavily skewed with nonnormal kurtosis. After the logarithmic transformation, the variable is almost symmetrically distributed and has negligible nonnormal kurtosis.

A more detailed analysis of our data reveals that the majority of investments are channeled to countries like, India, Malaysia, Thailand, Chile, Argentina, Indonesia, Philippines, Russian

Federation, Poland, among others. The private sector is more interested in financing infrastructure PPP in emerging countries, that possess important advantages for the attractiveness of private investment. Among the advantages are the dimension of the market and the fact that they are undertaking economic and political reforms, namely restructuring their economies along market-oriented lines and increasing the openness to trade. In essence, these countries offer major opportunities for private sector investors as they are the world's fastest growing economies.

By contrast, the zero investment values are concentrated mostly in poor countries of the Sub-Saharan Africa region (34% of the zero values). Many low-income countries are virtually overlooked with respect to private capital flows. Thus, investment flows exhibit a strong geographical distortion. The higher risk associated with these economies, as well as, their weak economic and institutional environments do not encourage private investors to enter in long-term and risky arrangements, like infrastructure PPP.

In what concerns the financial support provided by MDB, the majority of the flows are registered to emerging countries, like Brazil, Chile, India and Philippines. Although it may be surprising at a first glance, because their development role implies a focus on the poorer countries. A more accurate analysis leads to the conclusion that are the emerging countries that mostly need capital to finance their development and their infrastructure projects, relying in multilateral lenders.

Investments in PPP are conditioned by two sequential decisions. The first is the investors' decision as to whether or not to invest in a country and these countries are evaluated based on a number of relevant socioeconomic and country characteristic indicators, depending on the motives of the investors, that for private investors will be purely, profit maximization. The second decision has to do with "how much" to invest into the selected countries. Concerning the "financial support" provided by MDB, a two-step decision process may be also considered. First, based on the intrinsic characteristics of a country, the decision is taken of whether or not to provide support and next, the decision on the amount of support.

Based on the previous exposition, theoretically a Two-Part model or Heckman selection models seem to be appropriate to model the dependent variables. Table 6.21 presents the results obtained through the regression of the proxies for the different risk dimensions, on the *real dollar value of investments* in PPP. Different specifications were used, namely, a Tobit model,

a Two-Part model and Heckman selection model estimated by MLE, assuming a joint normal distribution for the unobservables of the two-parts.

Table 6.21: Determinants of investments in PPP

Dependent variable:	Tobit	Two-Part Model		Heckman MLE	
Real Dollar value		y>0	dy	y>0	dy
of investments (ln)	(1)	(2)	(3)	(4)	(5)
Political system	-0.278**	-0.068	-0.359**	-0.073	-0.366
	(-2.22)	(-0.57)	(-1.96)	(-0.53)	(-1.50)
Index Political Competitiveness	0.296***	0.158	0.193*	0.161	0.199
	(3.03)	(1.53)	(1.81)	(1.53)	(1.09)
Checks (number)	-0.040	-0.034	-0.054	-0.034	-0.056
	(-0.82)	(-0.85)	(-0.72)	(-0.89)	(-0.58)
Creditor rights	0.007	-0.042	0.076	-0.041	0.077
	(0.08)	(-0.62)	(0.69)	(-0.61)	(0.68)
Contract enforcement days (ln)	-0.255	-0.245	-0.026	-0.245	-0.022
	(-1.49)	(-1.59)	(-0.14)	(-1.63)	(-0.11)
English legal origin dummy	0.204	-0.132	0.673*	-0.124	0.682
	(0.84)	(-0.61)	(1.76)	(-0.46)	(1.62)
German legal origin dummy	0.520	0.380	0.288	0.382	0.287
	(1.41)	(1.01)	(0.55)	(1.03)	(0.55)
Socialist legal origin dummy	0.506	0.785*	0.104	0.782*	0.115
	(1.62)	(1.76)	(0.35)	(1.77)	(0.26)
Physical Integrity Index	-0.022	-0.027	0.010	-0.027	0.011
	(-0.40)	(-0.55)	(0.16)	(-0.55)	(0.16)
Empowerment Index	0.062	0.085*	-0.001	0.084*	-0.002
	(1.37)	(1.92)	(-0.02)	(1.89)	(-0.03)
Civil liberties	0.203*	0.166	0.103	0.166*	0.100
	(1.85)	(1.62)	(0.70)	(1.68)	(0.61)
Deposit money bank assets	0.552	0.493	0.274	0.495	0.283
	(0.95)	(0.95)	(0.37)	(0.96)	(0.37)
Liquid liabilities to GDP	0.774	1.109*	-0.654	1.105**	-0.659
	(1.25)	(1.99)	(-0.61)	(2.05)	(-0.61)
Private credit to GDP	0.635	0.493	0.085	0.493	0.080
	(1.22)	(1.13)	(0.08)	(1.17)	(0.08)
General government balance to GDP	-0.113***	-0.083***	-0.056**	-0.083***	-0.056**
	(-6.61)	(-5.80)	(-2.18)	(-4.63)	(-2.06)
External debt to total exports	-0.001	-0.001	0.010	-0.001	0.010
	(-0.19)	(-0.20)	(1.25)	(-0.20)	(1.17)
Economic growth	0.016	-0.001	0.018	-0.000	0.018
	(0.71)	(-0.03)	(0.76)	(-0.02)	(0.71)
Fuel exports	0.007	0.003	0.005	0.003	0.005
	(1.44)	(0.85)	(0.62)	(0.82)	(0.63)
Real GDP per capita (ln)	1.368***	1.093***	0.658***	1.100***	0.657***
	(11.72)	(7.71)	(3.42)	(6.55)	(3.39)
Inflation rate	-0.001*	-0.000*	-0.000	-0.000	-0.000
	(-1.89)	(-1.79)	(-0.85)	(-1.44)	(-0.85)
Population (ln)	1.296***	1.064***	0.549***	1.069***	0.551***
	(14.60)	(9.58)	(3.74)	(9.27)	(3.44)
International reserves	0.092***	0.058*	0.103**	0.058*	0.102*
	(2.77)	(1.83)	(1.99)	(1.95)	(1.71)
Time dummies	jointly significant***	jointly significant***	jointly significant***	jointly significant***	jointly significant***
Constant	-31.381***	-23.843***	-14.916***	-24.006***	-14.985***
	(-14.06)	(-11.59)	(-3.66)	(-8.17)	(-3.46)
Number of observations[a]	732	679	705	732	732
Log-likelihood value	-1503.90	-1192.95	-131.53	-1324.47	
(Pseudo) R-Squared	15.62%	60.64%	30.08%		
BIC	3271.63	2640.19	512.27	3123.83	

Legend: * statistically significant at 10% level, ** at 5% level *** at 1% level.
[a] When estimating the Probit of the Two-Part model, the 1994-dummy variable was dropped and 27 observations were not used due to collinearity problems.
Clustered robust t statistics in parentheses, except for Tobit.

The dependent variable is used in logs rather than levels, due to the fact that the methods used rely mostly in the normal distribution of the data. However, the log transformation does not exist for observations equal to zero. To overcome this problem we follow the approach proposed by Cameron and Trivedi (2009) in what concerns Tobit estimation. The adjustment used is to change the values of zero, to very small values, very close to zero, but that allow the use of $ln(y)$.[17] The Two-Part or Sample selection models are more appropriate because they use the zero observations without needing further adjustments.

The general analysis of Table 6.21 confirm that a country's economic conditions are fundamental in attracting PPP investments. Particularly, richer countries with larger markets attract more funds and macroeconomic stability is also important, as a controlled inflation and more reserves lead to a positive effect on investments through PPP. In addition, countries with higher deficits are penalized with lower investments through PPP.

Concerning the political environment, the higher the elections competitiveness, the higher the propensity for PPP investments. As expected, more transparent and accountable governments will create a more favorable environment for those projects. Sightly unusual is the sign and significance of the *Political system* coefficient, because it seems that more democratic regimes do not encourage infrastructure investments through PPP. Usually, democracy facilitates the adoption of market-oriented reforms, in which we include the choice of PPP to develop critical infrastructure projects in emerging countries.

Another controversial result is related to the civil liberties measure, that ranges from 1 for countries with complete freedom to 7, for those with no freedom. Apparently, more civil liberties are associated with lower investments in infrastructure projects. A possible explanation for this result is provided by Banerjee et al. (2006), who claim that more civil rights usually imply that projects to proceed must ensure civic approval, what in turn will increase the transaction costs and further increase the already lengthy process of structuring an infrastructure PPP.

Time dummies appear statistically relevant in all specifications. Not surprisingly time-specific events are systematic drivers of investment flows to infrastructure PPP.

[17] All censored observations of $ln(y)$ are set to an amount slightly smaller than the minimum noncensored value of $ln(y)$. This is not the most advisable procedure, although it consists in small variations from the original data.

These findings are supported by Hammami et al. (2006), who had found that larger markets, stable inflation and more political competitiveness lead to more PPP investments. In addition, a significant time effect was also reported.

If we focus our analysis in the Two-part model, more interesting conclusions can be drawn. In this specification (column 2 and 3), y is modelled first as a Probit regression for $y = 0$ versus $y \neq 0$ and next, the positive values are modelled with another distribution (using OLS, in this case). It is worth mention that the Probit model fits the data quite well, achieving 93.33% of observations correctly classified.

Therefore, in column 3, the results stress the importance of the institutional quality and of legal systems, that matter mostly for the decision whether to invest or not. Besides the importance of the political proxies mentioned before, it is also possible to see that countries with an English legal origin are rewarded with higher investments than French civil law countries. Column 2 highlights that for positive values of y, more developed financial systems and countries that respect more human rights (measured by the empowerment index) benefit with more investments. The economic variables, already mentioned, maintain in general their importance in the "two parts" of the model.

When we drop the assumption of independence of the two parts of the model, an alternative model can be used - the sample selection model estimated through MLE (Heckman MLE). In this specification, the same variables were used in both equations (selection equation and outcome equation). Columns 4 and 5 exhibit the results.

Comparing the results from the Two-Part Model and Heckman MLE, similar coefficient estimates were obtained in the two equations with almost the same statistical significance achieved. The log likelihood of the two models is respectively, -1324.48 *vs* -1324.47 and in addition the LR test of independence of the equations obtained with Heckman MLE, gives a p-value of 0.89. As such, the estimated correlation between the errors of the two-parts, is not significantly different from zero and the hypothesis that the two parts are independent cannot be rejected.

A two-step estimation was also performed using Heckit, but the same qualitative results were obtained and no apparent improvement was achieved (for convenience, results are not reported). Testing the hypothesis of independence of the errors, through the coefficient of lambda (the error covariance σ_{12}, in Equation 6.34), the z-statistic is 0.16 with a p-value of 0.88. Thus, we do not reject the independence of ϵ_1 and ϵ_2 in Equation 6.31, reinforcing the empirical evidence that favors the choice of a Two-Part Model.

Because multicollinearity problems may arise in the Heckman two-step procedure, given that exactly the same regressors are used in both equations for y_1^* and y_2^*, a collinearity diagnostic was performed with the inverse Mills ratio term $\lambda(.)$ and the other regressors. No serious problems were detected that worth correction, because all the VIF values are small (Mean VIF=1.97).

Summing up, we may say that the unobserved factors that explain the selection process are independent from the unobserved factors that explain the amount of investment and hence, the simpler Two-Part model is preferred over more complex formulations.

For comparisons purposes, also the classical Tobit model is presented in column 1. The results point in the same direction as the previous ones, but we must be careful in the interpretation of Tobit estimates given its fragility to misspecifications of the error distribution.

In order to investigate if the same factors that influence the total value of investments are close to the factors that drive the amount of financial support provided by MDB, we regress the same explanatory variables on the amount of support provided, using the previous model specifications. Table 6.22 presents the results.

Table 6.22: Determinants of the financial support provided by MDB in PPP

Dependent variable:	Tobit	Two-Part Model		Heckman MLE	
Real Dollar value		y>0	dy	y>0	dy
of MDB support (ln)	(1)	(2)	(3)	(4)	(5)
Political system	0.421	-0.145	0.136	-0.146	0.136
	(1.24)	(-0.97)	(1.38)	(-1.03)	(1.37)
Index Political Competitiveness	0.312	-0.205*	0.085	-0.205*	0.085
	(1.05)	(-1.72)	(1.04)	(-1.92)	(1.04)
Checks (number)	-0.131	-0.016	-0.025	-0.016	-0.025
	(-1.03)	(-0.22)	(-0.58)	(-0.24)	(-0.57)
Creditor rights	-0.454*	0.190*	-0.140**	0.190*	-0.140**
	(-1.92)	(1.89)	(-2.24)	(1.89)	(-2.24)
Contract enforcement days (ln)	1.232**	0.222	0.289**	0.222	0.289**
	(2.45)	(1.38)	(2.45)	(1.39)	(2.45)
English legal origin dummy	0.152	-0.078	0.063	-0.079	0.063
	(0.23)	(-0.32)	(0.28)	(-0.34)	(0.28)
German legal origin dummy	-1.804*	0.433	-0.510*	0.434	-0.510*
	(-1.78)	(1.36)	(-1.88)	(1.38)	(-1.87)
Socialist legal origin dummy	0.958	0.187	0.218	0.187	0.218
	(1.06)	(0.44)	(0.76)	(0.47)	(0.76)
Physical Integrity Index	-0.176	0.046	-0.058	0.046	-0.058
	(-1.18)	(0.73)	(-1.58)	(0.76)	(-1.58)
Empowerment Index	0.069	0.066	0.017	0.066*	0.017
	(0.56)	(1.53)	(0.45)	(1.65)	(0.45)
Civil liberties	-0.971***	0.069	-0.250**	0.070	-0.250**
	(-3.16)	(0.47)	(-2.48)	(0.47)	(-2.46)
Deposit money bank assets	2.705	1.573**	0.498	1.572***	0.498
	(1.62)	(2.57)	(1.09)	(2.75)	(1.09)
Liquid liabilities to GDP	2.239	1.093	0.497	1.092	0.497
	(1.30)	(1.41)	(1.29)	(1.52)	(1.29)
Private credit to GDP	-3.387**	-0.501	-0.837**	-0.499	-0.837**
	(-2.41)	(-0.90)	(-2.27)	(-0.94)	(-2.27)
General government balance to GDP	-0.063	-0.030	-0.011	-0.030	-0.011
	(-1.28)	(-1.39)	(-0.98)	(-1.50)	(-0.98)
External debt to total exports	0.022	0.016**	0.005	0.016**	0.005
	(1.25)	(2.02)	(1.08)	(2.18)	(1.07)
Economic growth	-0.008	0.010	0.002	0.010	0.002
	(-0.12)	(0.34)	(0.09)	(0.36)	(0.09)
Fuel exports	-0.001	0.007	-0.001	0.007	-0.001
	(-0.09)	(1.41)	(-0.37)	(1.51)	(-0.37)
Real GDP per capita (ln)	0.721**	0.378**	0.131	0.378**	0.131
	(2.26)	(2.26)	(1.28)	(2.35)	(1.27)
Inflation rate	-0.048***	0.003	-0.012**	0.003	-0.012**
	(-3.17)	(0.36)	(-2.30)	(0.36)	(-2.30)
Population (ln)	1.189***	0.317***	0.263***	0.316***	0.263***
	(4.84)	(3.03)	(3.36)	(3.10)	(3.36)
International reserves	-0.157	-0.011	-0.036	-0.011	-0.036
	(-1.63)	(-0.30)	(-1.46)	(-0.32)	(-1.46)
Time dummies	jointly	jointly not	jointly	jointly not	jointly
	significant***	significant	significant***	significant	significant***
Constant	-40.483***	-8.754***	-8.492***	-8.735***	-8.491***
	(-6.07)	(-3.15)	(-5.23)	(-3.13)	(-5.22)
Number of observations	732	286	732	732	732
Log-likelihood value	-1082.73	-458.48	-415.91	-874.39	
(Pseudo) R-Squared	7.06%	31.86%	15.08%		
BIC	2429.28	1131.88	1089.06	2217.08	

Legend: * statistically significant at 10% level, ** at 5% level *** at 1% level.
Clustered robust t statistics in parentheses, except for Tobit.

In a first analysis, it is interesting to note that some factors which drive the number of PPP with MDB participation (see Table 6.16) appear also as relevant determinants of the financial support provided by those agencies, namely, *Contract enforcement days, External debt* or *Inflation rate.*

Focusing the analysis on the results from the Two-Part Model (columns 2 and 3), it is now possible to disentangle factors that determine the decision to provide financial support, from factors that drive the "amount" of such financial support, allowing a richer analysis.[18]

Factors that influence the MDB decision to provide financial support include measures of legal risk, corroborating the intuition that riskier countries have a higher probability to benefit with this support, in an attempt to create a protective umbrella. Also interesting is the sign and significance of the *Civil liberties* measure, showing that countries that do not respect freedom (with higher values in this indicator), are penalized with lower MDB involvement (what gives support to hypothesis 7, developed in Section 6.3).

Concerning the economic and financial factors, a controlled inflation will improve the probability of a MDB financial support and countries with higher *Private credit* will need less this support. Time-dummies appear particularly relevant in explaining the decision to provide financial support. All coefficients are positive and statistically significant, showing a positive trend over time (individual coefficients not reported).

Factors that explain the "amount" of financial support include some common factors that drive overall PPP investments, like higher GDP per capita and the size of the market. In addition, countries with higher debt levels, will benefit with higher MDB flows. More interesting is the variable *Creditor rights*, that invert the sign in the two-parts of the model. It appears that once the decision is taken to provide financial support to a riskier legal country, the amount of such support will increase for countries that recognize more rights to creditors.

In addition, statistically relevant appears the variable *Deposit money bank assets*, the higher the role of commercial banks in the financial intermediation, the higher the level of MDB flows. Riskier political environments characterized by a lower level of elections competitiveness, will lead to higher amounts of support, as expected.

[18]It is worth to emphasize that this analysis is different from the one presented in Section 6.6.2 - concerning the probability of a MDB participate in a PPP project - because previously the unit of analysis was the PPP project, and in this section, the analysis is developed per country and year.

Comparing the models, the joint likelihood of the Two-Part model is exactly the same as the LL value of the Heckman MLE model, -874.39. A close analysis of the results, comparing the Two-Part Model and Heckman MLE, shows that there is no particular difference between the coefficient estimates and their statistical relevance, for both equations ($y > 0$ and dy).

Once again, empirical evidence favors the Two-Part model over other specifications. More specifically, the LR test of independence of the equations obtained with Heckman MLE gives a p-value of 0.988, reinforcing the hypothesis that the two parts of the model are independent.

Heckman's two-step procedure (or Heckit estimator) was also used (for convenience, results are not reported). The results obtained show equal magnitude of the coefficients but some minor differences appear in their statistical significance, when compared with Heckman MLE. This could be partially explained by the fact that clustered robust standard errors are being used when possible, but Heckman's two-step do not allow for that option (STATA automatically makes the correction for heteroscedasticity). Nevertheless, testing the hypothesis of independence of the errors, the lambda coefficient shows a p-value=0.984. Hence, we do not reject the independence between the errors of the two equations.

Once again, because the Heckit procedure is susceptible to collinearity problems, similarly to what was exposed previously, a multicollinearity diagnostic was performed relating the inverse Mills ratio term and the other regressors and no apparent problems were found.

To shed more light into the significance of the different risk dimensions, Table 6.23 presents LR tests using a Two-Part model. Assuming independence of the two equations, LR tests are performed for the "two parts".

Table 6.23: Likelihood Ratio tests for PPP investments and MDB financial support

LR tests	**Dependent variable**			
Two-Part Model	Real Investment in PPP		Real MDB financial support	
N=732	dy	$y > 0$	dy	$y > 0$
Risk dimensions:				
Political	7.98**	5.24	4.10	4.32
	(0.0465)	(0.1553)	(0.2510)	(0.2292)
Legal	6.71	17.78***	14.26**	8.73
	(0.2433)	(0.0032)	(0.0140)	(0.1205)
Social	0.67	9.00**	15.12***	3.00
	(0.8794)	(0.0292)	(0.0017)	(0.3922)
Financial	1.01	30.92***	6.62*	8.13**
	(0.7991)	(0.0000)	(0.0849)	(0.0435)
Economic	54.75***	342.47***	41.24***	47.05***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Time Dummies	45.28***	48.30***	36.72***	16.89
	(0.0001)	(0.0000)	(0.0023)	(0.3930)

Legend: * statistically significant at 10% level, ** at 5% level *** at 1% level, p-values in brackets.

The results above reinforce the earlier conclusion that factors which influence the decision to invest or to provide financial support are quite different from those which determine the amount of such financial flows. More particularly, if we consider PPP investments, a stable political environment, good economic prospects and the time effect explain the decision to invest. Although if we consider the investment level, there is evidence in favor of all risk dimensions except the political environment.

Concerning the financial support provided by development banks, all the dimensions are relevant to explain the decision to provide financial support, except the political – besides the relevance of the time effect and of the economic variables, also the respect for human rights is an important driver for this decision, as expected. In respect to the amount of financial aid flows, only financial and economic factors appear to be relevant.

6.7 Summary and suggestions for further research

Infrastructure projects are prone to specific risks given its nature and usually imply commitment for longer maturities, what makes investors particularly exposed to risk. Therefore, private lenders should evaluate the different risk factors, project specific but also, related to the country environment where the project will be developed. This risk assessment will be reflected in the willingness to enter in a PPP arrangement and in the degree of such commitment.

Aggregate empirical studies that evaluate country-specific determinants of infrastructure PPP, allow to detect trends and provide useful insights about the macroeconomic and structural characteristics that may encourage the intensity of investments and the participation of the different agents.

A first conclusion of this work is that economic conditions constitute the most important risk dimension, as determinants of PPP in infrastructure, particularly, the dimension of the market and users' purchasing power.

Concerning private sector participation, our results support the arguments that the degree of private sector participation is higher for richer and less populous countries with a common law legal origin and with less developed financial systems. Also, projects with MDB participation have a higher degree of private sector involvement, highlighting the MDB "enabling" function, as the perceived level of risk is reduced to the private agents.

In respect to the hypotheses drawn in Section 6.3, hypothesis 2 is confirmed through the variable *Checks*, but hypotheses 4 and 6 are only corroborated partially – with *Contract enforcement days, Creditor rights* in the legal dimension and *Population, Fuel and Liquid liabilities to GDP* in the economic and financial dimensions exhibiting wrong signs and contracting the idea that the degree of private participation is higher for countries with lower risk levels. Explanations were already presented and are related with the web of contractual and financial agreements inherent to PPP and with the fact that the majority of private participation is external participation that compensate a lack of financial resources in the home country, among other factors. In respect to hypothesis 8, there is no evidence of higher private involvement for countries that respect more human rights and as such, this hypothesis is rejected.

MDB participate more in infrastructure projects developed in poorer (measured by *GDP per capita* and *international reserves*), less populous countries and with legal and financial systems underdeveloped, as expected. Our findings support the hypotheses 3 and 5. Political variables are not statistically significant, therefore rejecting hypothesis 1. Concerning human rights variables, the evidence is mixed - on one hand, MDB's participation appears as a response to the social risk and on the other hand, also as a rewarding mechanism to more socially responsible countries, what confirms hypothesis 7 only partially.

In respect to the number of PPP projects, more transparent governments, richer and larger markets with higher prospects of economic growth and countries with lower deficit levels benefit with a higher number of infrastructure projects, corroborating our hypotheses 2 and 6. Yet, the legal and social dimensions are not particularly relevant, rejecting hypotheses 4 and 8. A pronounced time effect is also evident.

In what concerns the number of projects in which MDB participate, macroeconomic stability is rewarded over the market dimension. In addition, a "risk effect" was evident, as riskier legal environments and countries with higher debt levels, have more "MDB projects". As such, hypotheses 3 and 5 are confirmed, with *Contract enforcement days, Private credit to GDP, External debt* and *Fuel exports*. By contrast, social and political variables are not relevant and as a consequence, hypotheses 1 and 7 are rejected.

About financial flows to PPP, investment decisions were taken based mostly on the favorable economic prospects, but also the institutional environment, measured by political and legal variables, matters to explain the decision to invest. The intensity of such investments is essentially a response to the financial and economic conditions of the host countries, besides an evident time effect. Our findings gives support to hypothesis 6 and only corroborates hypotheses 2 and 8 partially through the variables of *Index of political competitiveness* and *Empowerment Index*, because *Political system* and *Civil liberties* exhibited the wrong sign. Legal variables individually do not appear specially relevant, although jointly they are statistically significant, as the LR test performed showed.

Extending the analysis to the financial support provided by MDB, all the risk dimensions are important determinants for the decision to provide support, except the political, meaning that MDB evaluate the overall environment of developing countries as a critical pre-requisite for providing financial aid flows, in particular, social and economic factors. To explain the level of support, more relevant appear the economic and financial dimensions.

Our findings suggest that hypotheses 1 and 7 are verified, with *Index of political competitiveness* and *Civil liberties* showing the expected sign. Riskier legal and financial countries apparently are benefited on the MDB' decision to give financial support, corroborating hypotheses 3 and 5, but in what concerns the amount of the financial support, the opposite effect is verified. It seems that in the decision phase of whether or not to give support, riskier countries are preferred, but when deciding the amounts of the financial support, countries that exhibited lower levels of legal and economic/financial risks are preferred.

At this point, it is relevant to mention some of the limitations of the present empirical study and simultaneously, to present topics for further research. First, the level of a country's risk, assessed in different dimensions, is measured based on variables that were chosen purely on the basis of theoretical relevance and data availability. It is not possible to know in advance, if the same results will be obtained through a different set of explanatory variables used as proxies for the same risk dimensions.

Second, in what concerns the MDB involvement in PPP, we only consider characteristics of the recipient country to explain the probability of such involvement, also expressed in the number of projects and in the amount of the financial support. However, related literature on aid allocation may be considered, extending our analysis to include variables for the "donor interest". McGillivray (2003) mentions that for aid allocation, one modelling approach to be followed is the "recipient need and donor interest". This empirical framework is based in two assumptions – the recipient need model assumes that donors are motivated purely by humanitarian motives and, the donor interest model is premised on the assumption that donors are motivated purely by commercial, political and strategic self interests. In this research, it was used only variables that characterized the recipient countries and as an interesting topic for future research, we may consider to include variables specifically related to the MDB, although for the moment these data are not readily available, as far as we know.

Third, an important issue is that of potential unobserved effects or omitted variables. Specific geographical units, countries or regions, have characteristics that lead them both to have higher performance (growth, productivity) and to develop more infrastructure projects and if these aspects are unobserved, a methodological problem arise. In this empirical research to deal with this issue, we used the pooled approach with clustered robust standard errors, a simpler panel data method, but robust in many situations except when unobserved heterogeneity is correlated with the regressors, demanding a fixed effects approach. Nevertheless, given the complexity of some of the methods used, panel data estimation with fixed effects for these methods is still an open subject in econometrics, but future research may consider to use more sophisticated panel data formulations.

Fourth, new dimensions should be explored as potential determinants of infrastructure PPP: a geographical and a technological dimension. Geography is documented as a key determinant of the investment decisions either domestically or internationally (see Sarkissian and Schill, 2004), and is expected to have an effect in infrastructure investments under PPP schemes, as well. Technological factors, such as R&D expenditures and innovation, also matter to explain the attractiveness of the markets to investors (see Porter, 1990). At this purpose, it should be recalled that our data include information on emerging countries, where technological aspects appear as potential drivers for growth and development.

To conclude, given the popularity of PPP and their exponential growth in recent years also with a lot of controversy around the theme, it is expected that this study exploring new branches, could add to the scarce empirical literature on the field and contribute to further research.

Chapter 7

Conclusion

Public Private Partnerships (PPP) are widely used to cope with infrastructure deficits all over the world. More efficiency and effectiveness on the public sector side and more infrastructure assets and services are now required by a more active society, contributing to reinforce the trend of private sector involvement in infrastructure businesses. Particularly relevant to developing countries, PPP appear as the only mechanism available to finance important infrastructure projects - the reason why PPP are supported by the World Bank, among others Multilateral Development Banks (MDB).

Access to new sources of finance and enjoying private sector management skills can reduce costs and improve quality, generating greater VfM. In a partnership, public and private partners share a clear and common purpose, risks and responsibilities. PPP projects are by nature long-term investments involving several participants in complex financial and contractual structures. Over the lifespan of these projects the political, legal, social, financial and economic environment could all change significantly. This is particularly true for developing and emerging countries, where the institutional, social and economic conditions are less stable, contributing to the enhancement of risk and uncertainty.

In this scenario, an adequate identification, assessment and evaluation of risks is particularly important. To understand how the different risk factors affect agents' participation and the intensity of infrastructure PPP projects, expressed in their number and value, is valuable for policy reasons and for all engaged in the PPP market. Few academic research has been done and conclusions of earlier articles have often been only partial or contradictory contributes to justify this research.

In addition, in what concerns the Portuguese reality, one can witness a lack of academic research on PPP, in spite of the long Portuguese history with these partnerships and their macroeconomic significance.

Consequently, this thesis made two different contributions:

First, the empirical study performed explains what are the main drivers for the degree of private sector involvement in PPP and explores the MDB' role of risk reduction, topics, as far as we know, not yet studied. In a brief summary, two conclusions seem to be immediate: (1) the results have pointed to the dominance of the economic conditions and of the legal framework, which constitute the most important risk dimensions, in explaining the agents' participation in PPP; (2) MDB' participation is higher for riskier countries, corroborating in general the hypotheses developed – *the probability of having a PPP with a MDB participation is positively related to the level of a country's risk*, emphasizing the mechanism of risk reduction.

In parallel, the determinants of the number of projects and of financial flows to PPP, are explored. The evidence reinforces the importance of the economic conditions, particularly the dimension of the market and users' purchasing power, and of the time-effect.

It is worth to mention that one innovative aspect of this empirical approach, is to test simultaneously a vast variety of variables, proxies for the different risk dimensions of a country, providing a more complete "picture" of the determinants of infrastructure flows and of the participation of the different agents to developing / emerging markets.

Second, presenting the PPP Portuguese experience, although focusing in only five cases, enhances the knowledge in the PPP field and sets out some key issues as determinants of success, as well as, the main challenges for the near future. The analysis of the five PPP lead us to the following recommendations mostly to the public sector: (1) a system of lessons learned must be created, within a true PPP agency, with the goals of information sharing and accumulating knowledge. At the same time, this system will improve the negotiation skills and will avoid past errors, bringing more flexibility to deal with risks and uncertainties inherent to PPP projects; (2) affordability must be ensured all over the life of the PPP project, a long-term perspective is an imperative requisite for successful PPP; (3) particularly about transport projects, more

realistic traffic projections must be developed to avoid negative financial consequences; (4) finally, as a "partnership" communication and interpersonal relationships should be nurtured among all participants in a PPP.

Additionally, because efficiency and performance are concepts that are hard to measure, we proposed a Data Envelopment Analysis (DEA) model to evaluate the relative efficiency in an application to road concessions (namely, the seven SCUT projects), but that could be extended to different sectors, conditioned on the availability of proper data.

To sum up, this study makes an important contribution to the literature, due to the scarcity of papers on the Portuguese reality, moreover when the available information is dispersed over different sources.

Several limitations to this research have already been mentioned throughout the work. It is worth to recall that, concerning the PPP Portuguese case studies, conclusions are only possible to the cases under analysis. No generalizations are possible. Similarly, using DEA, conclusions are only possible for the projects under consideration. In a comparison with the "best" project, the other projects are ranked. Nevertheless, important insights have been obtained. In the empirical application developed in Chapter 6, limitations are mostly related to the variables and methodological approaches used and have been detailed in the previous section.

As a final note, the path to search a deeper understanding of PPP in all their features, merits and flaws is open. Further research is expected to contribute to an objective and impartial assessment of PPP.

Data Appendix: Countries' information

Table 1: Countries considered in the empirical analysis

Country	Freq.	Percent	Country	Freq.	Percent
Albania	9	0.43	Madagascar	8	0.38
Argentina	181	8.64	Malawi	3	0.14
Armenia	4	0.19	Malaysia	89	4.25
Bangladesh	14	0.67	Mali	2	0.1
Benin	2	0.1	Mexico	60	2.86
Bolivia	27	1.29	Moldova	4	0.19
Brazil	324	15.47	Mongolia	2	0.1
Bulgaria	20	0.95	Morocco	12	0.57
Burkina Faso	2	0.1	Mozambique	10	0.48
Cambodia	6	0.29	Nepal	2	0.1
Cameroon	2	0.1	Niger	3	0.14
Chile	103	4.92	Nigeria	14	0.67
Colombia	90	4.3	Pakistan	37	1.77
Congo, Rep.	1	0.05	Panama	17	0.81
Costa Rica	26	1.24	Paraguay	5	0.24
Cte d'Ivoire	9	0.43	Peru	42	2
Dominican Republic	6	0.29	Philippines	81	3.87
Ecuador	24	1.15	Poland	44	2.1
Egypt, Arab Rep.	18	0.86	Romania	7	0.33
El Salvador	16	0.76	Russian Federation	65	3.1
Georgia	9	0.43	Rwanda	2	0.1
Ghana	7	0.33	Senegal	7	0.33
Guatemala	25	1.19	South Africa	21	1
Honduras	10	0.48	Sri Lanka	13	0.62
India	253	12.08	Tanzania	13	0.62
Indonesia	77	3.68	Thailand	92	4.39
Jamaica	10	0.48	Togo	3	0.14
Jordan	8	0.38	Tunisia	6	0.29
Kazakhstan	19	0.91	Turkey	33	1.58
Kenya	12	0.57	Uganda	10	0.48
Kyrgyz Republic	2	0.1	Uruguay	13	0.62
Latvia	5	0.24	Venezuela, RB	15	0.72
Lesotho	1	0.05	Vietnam	18	0.86
Lithuania	9	0.43	Yemen, Rep.	3	0.14
Macedonia, FYR	3	0.14	Zambia	5	0.24
			Total	**2,095**	**100**

Note: Information is showed for the larger database. For the other databases mentioned in Section 6.5, the same countries were considered but with fewer observations.

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Declaration of originality

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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- Basílio, Maria - *The Private Sector Participation in infrastructure PPP: An empirical analysis* - XXI Jornadas Luso-Espanholas de Gestão Científica, Cordoba, 2 a 4 Fevereiro de 2011.

- Basílio, Maria - *Infrastructure PPP investments in emerging markets* - EFMA European Financial Management Association, 2011 Annual Meetings, University of Minho, Braga, June 22-25, 2011.